Fogmaker®

Operation and Installation Manual

Water Based Fire Suppression for Enclosed Spaces

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Fogmaker® is a registered trademark for an automatic fire suppression unit intended to suppress fires for Class A surface burning and Class B fires within an enclosed volume.

The suppressant creates a cold water fog that not only cools down the temperature very rapidly and effectively, but also forces out the air so that the oxygen content is reduced. The effectiveness of the suppressant increases when the fluid is vaporized from exposure to heated surfaces as a result of the fire.

Fogmaker® operates and releases the suppressing fluid completely regardless of the installation position of the piston accumulator. This is based on a patented solution that makes the function more secure than the traditional fire suppression canister or cylinder type where a rising pipe is used which reduces or completely eliminates the function when suppressing if the piston accumulator is hung or held nearly horizontally or upside down. The piston accumulator is designed of aluminium alloy which is anodized to about 20 µm, which makes it very resistant to corrosion, even in demanding environments such as salt sea air.

The suppressing fluid is water-based and has frost-protection additives and film-forming chemicals that impede re-ignition in leaking fuel.

How does it operate?

The Fogmaker® high-pressure agent in the piston accumulators suppresses fires with the help of three basic mechanisms. All three operating modes depend on the size of the drops.

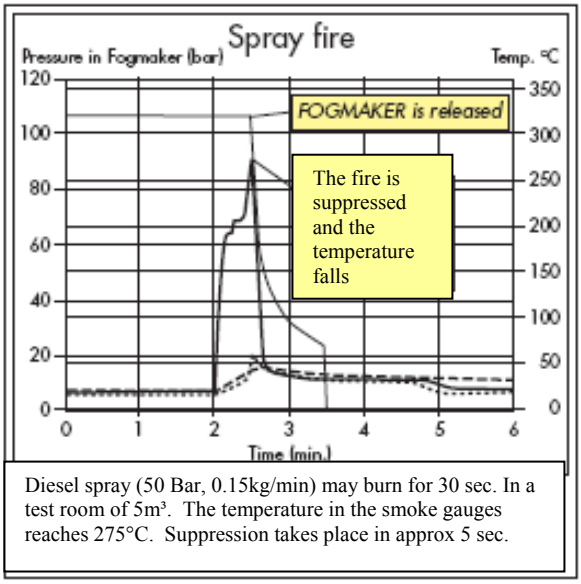
The high pressure, 940 psi (65 bar), and special nozzles break the water down into very small drops. The average size of the drops is approximately 80 µm. As a simple comparison, 2,000 of these small drops equal the volume of one drop with a 1 mm diameter!

One liter of water requires 335 kJ in order to be heated up from +20° to +100° C and a further 2,257 kJ in order to turn from water into steam. Water is a well-known fire suppressant.

Upon vaporization, 1 liter of water expands to 1,700 liters of steam. The oxygen content is reduced very effectively and smothers the fire from its center, where the oxygen content is at its lowest, and prevents new oxygen from being added. Besides water, the suppressing agent also contains antifreeze and AFFF, a foam maker which is a very effective suppressing agent for fire in petrol, diesel, or oils.

Test fire in a 2.5 m3 ”engine room”. The source of the fire consists of four troughs, 20x40 cm, filled with diesel as well as a diesel spray, 1 lit/min 5 bar, which sprays the engine. The heat effect is approximately 600 kWh.

Pictures are taken at approximately 4-second intervals. The temperature drops during this time from slightly more than +400 °C to +40 °C. During these 12 seconds, approximately 7.5 L suppression fluid is used.



Diesel spray (50 Bar, 0.15kg/min) may burn for 30 sec. In a test room of 5m³. The temperature in the smoke gauges reaches 275°C. Suppression takes place in approx 5 sec.

Note that only components from Fogmaker® may be used. If other components are used, Fogmaker® will not guarantee the unit function.

Components in this manual marked with an asterisk (*) are not UL listed.

List of contents

Page

PART ONE: SYSTEM OVERVIEW

Section 1 Piston Accumulator 7
1.1 General Description 7
1.2 Suppression Fluid 9
Section 2 Release Valve & Microswitch 9
Section 3 Activation 11
3.1 Mechanical Activation 11
3.2 Hydro Pneumatic Activation 11
3.3 Electrical Activation 13
Section 4 Alarm Panels 14
Section 5 Nozzles 15
Section 6 Hydraulic Hoses 16

PART TWO: INSTALLATION

Section 7 Installation of Piston Accumulator 17
7.1 Installation Dimensions 19
Section 8 Installation of Safety Screw Microswitch 25
Section 9 Installation of Mechanical Activation Cables 26
Section 10 Installation of Electrical Activation Switch 29
Section 11 Installation of Hydro Pneumatic Detection System 30
11.1 Installation of Detection Tube 30
11.2 Pressurizing of the Detection Tube 35
11.3 Detection Cylinder 36
11.4 Signal Processing from the Pressure Switch 37
11.5 Connection of the Detection Tube to the Connectors 38
Section 12 Installation of Nozzles 39
Section 13 Installation of Pipe Systems 41
Section 14 Installation of Hydraulic Hose 43
Section 15 Unit Limitations for UL-Listed Components 44
15.1 Detection Tubing 44
15.2 Pipe System 44
15.3 Nozzles 45
Section 16 Arm/Disarm Instructions 45
16.1 Standard Valve 45
16.2 Valve for Electrical Activation 47
Section 17 Functional Check After Installation 49
Section 18 Action in Case of Fire 50
Section 19 Actions After Suppressing 50
Section 20 Control Plan for the Suppression System 50
Section 21 Effect of Suppressing 51
Section 22 Function Reset After a Fire 51
Section 23 Winter Storage 52
Section 24 Technical Data 52
Section 25 Material Safety Data Sheets (MSDS) 53
Section 26 Performed Functional Tests and Technical Approvals 63

Warranty Policy 64
Inspection/Service/Installation Checklist 66

PART ONE: SYSTEM OVERVIEW

Section 1 The Piston Accumulator

1.1 General Description

The suppression fluid container is available in different versions depending on the volume of the piston accumulator. Fogmaker® 3.3 L*, 4 L, 6.5 L* and 7.5 L consist of one container. The 6 L*, 8 L*, 13 L* and 14 L* consist of two containers linked by a hose connection. 8 L*, 13 L*, and 14 L* systems are used primarily in larger machines and vehicles. They have sufficient capacity to be connected to a pipe system with up to approximately 11-15 nozzles. As a comparison, a 4 L piston accumulator manages up to 6-8 nozzles (3-6 nozzles in units with UL-listed components). The piston accumulator is pressurized with nitrogen to approximately 940 psi (65 bar), which is the rated operating pressure of the system at 70°F/21°C.

Warning: Never lift the piston accumulator by the gauge.

Dimensioning of the system:

Allocate **2 liter suppressant** for every cubic meter volume (gross) of the enclosed volume.
Desired **discharge time** should always be between **40-75 seconds.**
The choice for the number of nozzles depends on the criteria above.

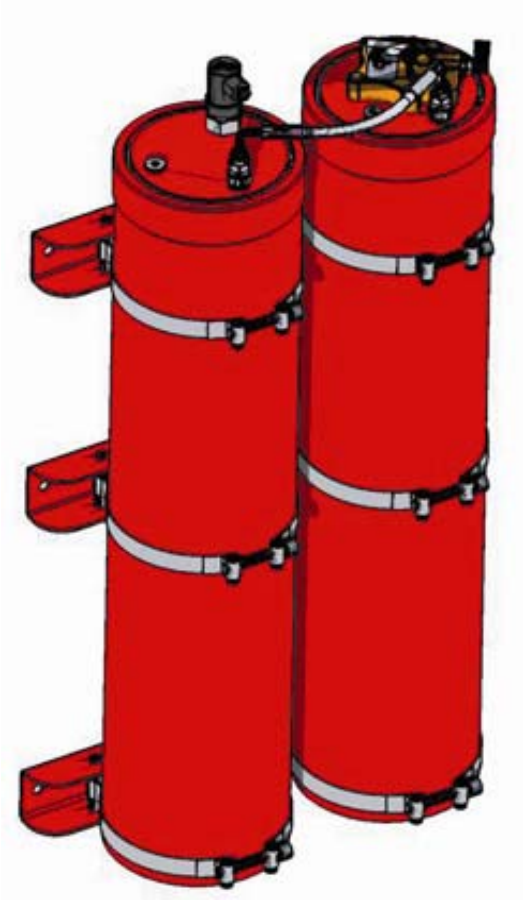


Fig. 1.1 Double piston accumulator*.

Fig. 1.2 Single piston accumulator.

The suppression system consists of: piston accumulator (1), release valve (2), connector for detection tube (3), safety valve (optional per DOT requirements) (4), outlet for suppression fluid with protective plug (5), refilling connection for suppression fluid (6), bracket (7), brace (8), manometer (gauge) (9), pressure switch* (optional) (10) safety screw (11), bracket, double piston accumulator* (12), cylinder 2* (13), brace, double piston accumulator* (14), interconnection hose* (15). The bottom of the container has a refilling connection for the propellant.

Fig 1.3 Construction of double piston accumulator*.

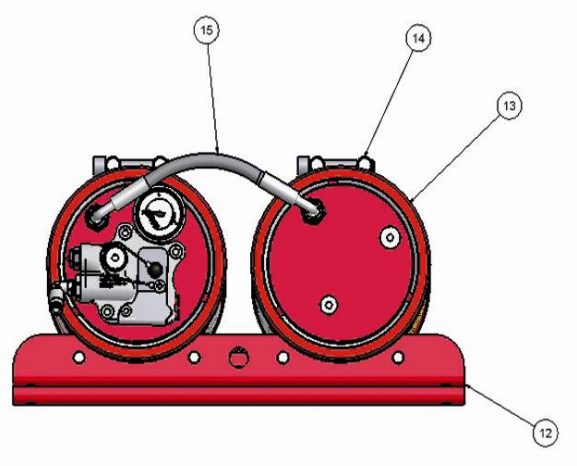
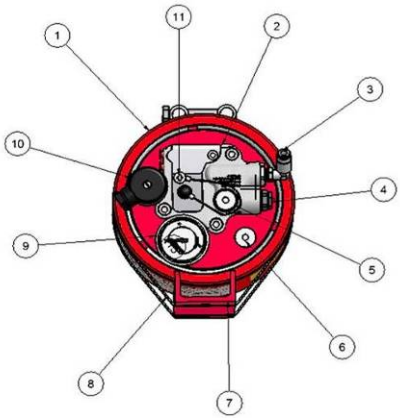


Fig. 1.4 Construction of single piston accumulator.



The protection plug (5) must always be in position during installation, service, and transport of the piston accumulator. The safety screw (11) prevents unintentional activation and must always be in position during assembly, disassembly or service, and during transport if the accumulator is pressurized. The safety screw may not be removed until the whole pipe system is installed and the piston accumulator system is made active. Let the safety screw hang on the cable when it is not screwed in.

Installation fittings (7) and braces (8) for single cylinder, installation fittings* (12) and braces* (14) for double cylinders* are included. Screws are not included. The type of screw to be used depends on the method and location for the installation. The double cylinder has the installation fittings attached on delivery. These must not be removed in connection with the installation since there would be a risk that the connections between the hose and the top of the container could leak as a result.

Multiple suppression units should not be interconnected. Fogmaker® can supply dual- and triple-piston accumulator units* to cover a wide variety of fire suppression needs. **Multiple-piston accumulator units are not UL-listed.**

WARNING

Do not tamper with the release valve or the top of the piston accumulator when the system is pressurized. The pressure in the system may be released resulting in personal injury. Do not loosen or remove the safety screw (11) before the installation of the system is complete.

1.2 Suppression Fluid

The suppression fluid is based on frost-protected water with additives of a film-forming chemical that impedes the re-ignition of leaking fuel and improves the suppressing characteristics. The standard suppression fluid is available in three versions for protection to - 30°C*, -15°C*, and 0°C. See Section 23 for additional information.

Section 2 Release Valve

Fogmaker´s ® patented release valve is available in three different versions: 1) a fully mechanical valve that is activated manually with one to four cables*; 2) a fully automatic electric valve* that is activated either by a detector cable, heat sensors, or smoke sensors; or 3) a hydro pneumatic, fully automatic valve that is activated by a detection tube pressurized by a detection fluid container. Electrical activation* can be combined with mechanical cable activation*.

The release valve is designed with an outlet opening for the discharge of the suppression fluid into the piping of the system. For safety reasons the outlet opening is provided with a protection plug that shall always be in position during service and transport of the pressurized piston container. A stainless steel pipe should be used to connect the outlet opening (which has a 1/4” BSPT thread) and the pipe system with nozzles. See Section 13 for further details on installing the pipe system.

The release valve is secured against unintentional activation by a safety screw that must always be in position during service or assembly/disassembly of the piston accumulator. The safety screw should be removed when the container is installed and the system is activated. The safety screw is retained by a hanging wire to the valve for future use.

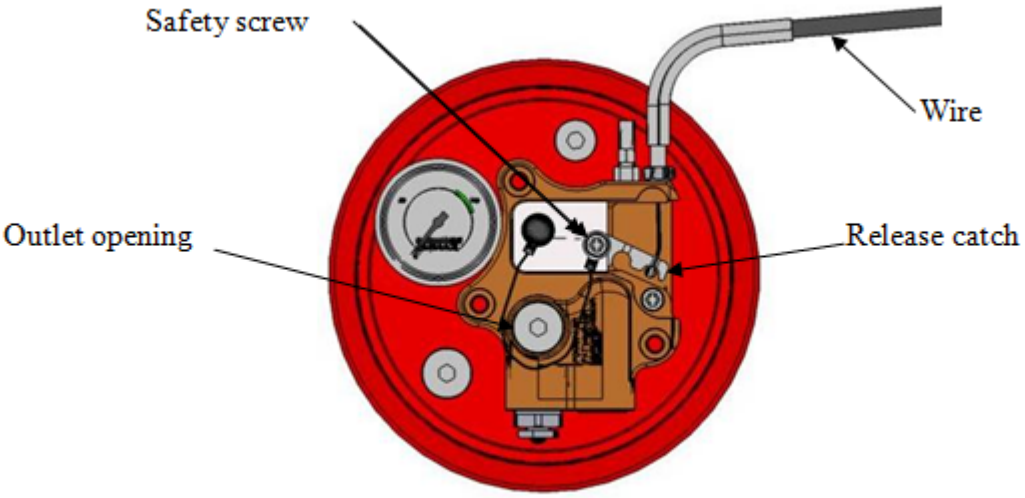


Fig 2.1 Release valve for mechanical activation. One protecting plate removed.

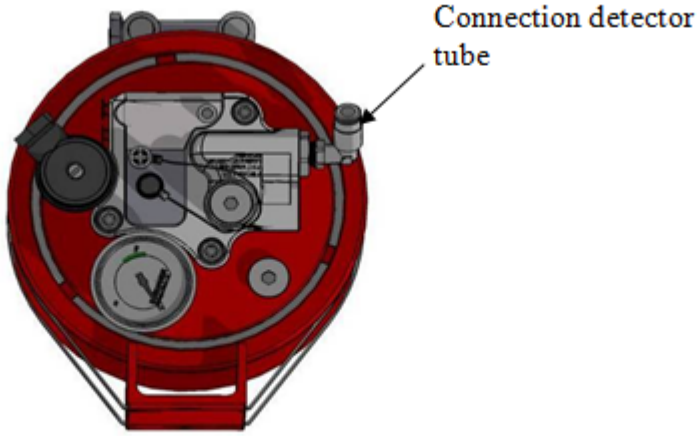


Fig 2.2 Release valve for hydro pneumatic activation.

Safety Screw Microswitch*

The safety screw microswitch (part no. FMWH-1117-001) is used to alert the operator when the Fogmaker® system is armed or disarmed. When the screw is inserted in the micro switch, the control panel display will indicate system ready. When the safety screw is inserted into the release valve assembly, the system-disarmed service light will become illuminated.

Section 3 Activation

3.1 Mechanical Activation – Cables*

Two to four activation cables can be connected to the mechanical valve (see fig. 3.1, below). The cables are fastened with steel-rubber braces (p-clamps) and screws on a wall or equivalent. Braces for the fixture of the cable should be located approximately 300mm apart from each other along the casing of the wire.

It is important that the cable is installed in such a way that it is not exposed to breakage or acute bends that would prevent or impede activation.

The end of the cable is equipped with a pull handle assembly that should be fixed/mounted in an easily accessible position outside the space that the Fogmaker® system shall protect in case of fire. For installation in vehicles one of the pull handles is to be located in the operator/driver location and the other on the outside of the vehicle. The pull handles are equipped with shackle locks that can be sealed. The external handle should be located where it will not be damaged by branches or other obstacles.

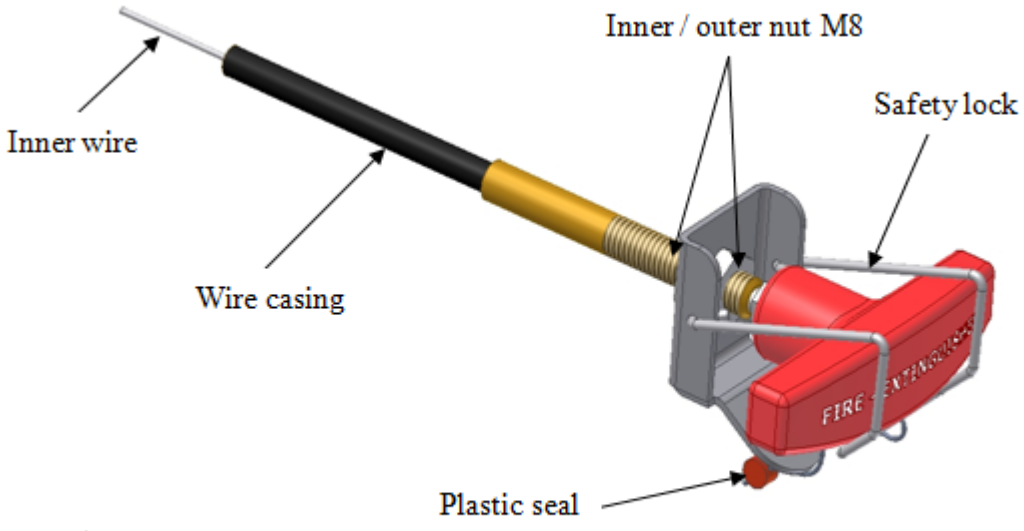


Fig 3.1 Construction of wire with Pull Handle Assembly.

3.2 Hydro Pneumatic Activation

The hydro pneumatic detection system is fully automatic and operates without the need for electricity or other types of external energy.

The system consists of:

- The cylindrical 1 L detection container that is filled with 500 ml detection fluid and nitrogen gas. The pressure of the container on delivery (24 bar or 31 bar) is established during the design of the system. See Section 11 for additional information.
- The sensor that consists of a detection tube designed of a polymer material, with an external diameter of 6 mm that connects the detection container to the piston accumulator release valve.
- Various installation material, special 6 mm connectors, protection tube, protection spiral, labels, etc. (See figs. 11.1 and 11.2.)

Note that only components from Fogmaker® may be used. If other components are used, Fogmaker® will not guarantee the system function.

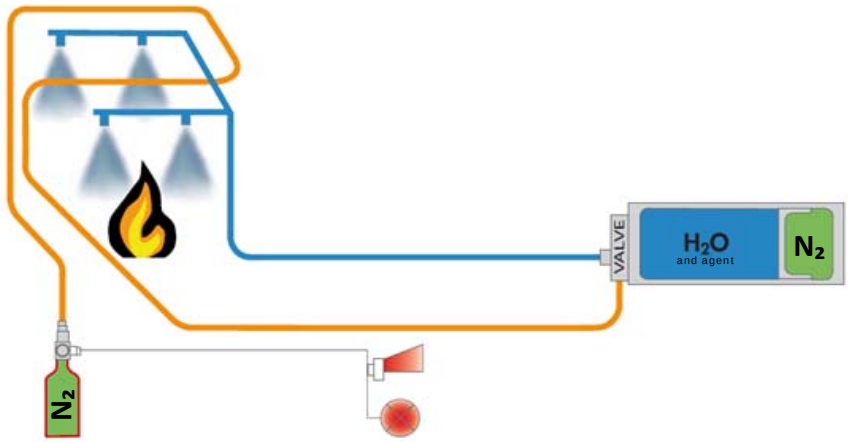


Fig 3.2 Hydro pneumatic activation.

The detection tube is vulnerable and must be installed with care. Damage to the surface of the detection tube can lead to cracks that may create leakage in the system resulting in the release of the suppression fluid.

During a fire event, the polymer material around the detection tube is perforated, allowing the pressure in the detection system to drop and the piston accumulator valve to open, releasing the suppressing fluid.

The detection cylinder has a pressure switch normally open (NO)* as standard and can have another NO pressure switch* as an option. The standard pressure switch gives a warning signal at less than14 bar which means the system pressure is too low. The optional pressure switch gives a signal at less than 5 bar which means the system has activated.

As an option there is also a manual punch* that can be installed on the detector tube. This allows an operator to manually activate the system by cutting the detection tube.

Fig 3.3 Table for system pressure and detection temperature.

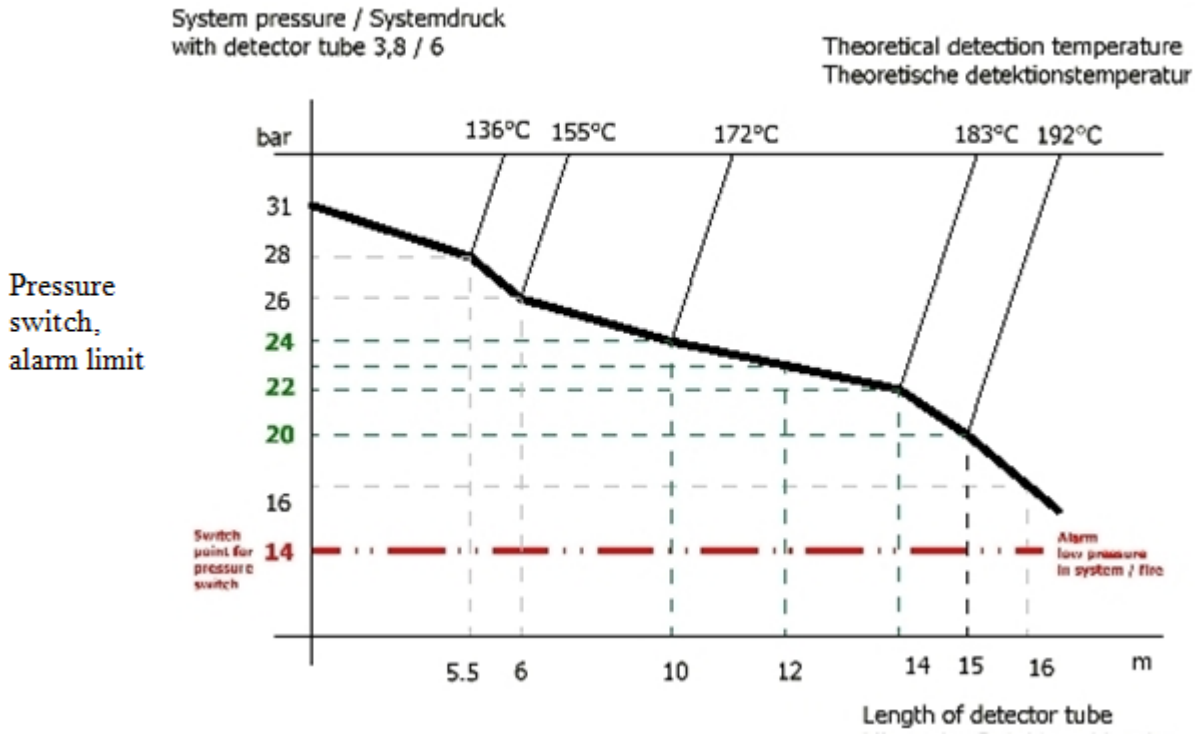


Fig. 3.4 part no. FM-1657-02 double pressure switches 14 and 5 bar.

Fig. 3.5 part no. FM-1656* pressure switch 14 bar and T-connector.

Fig. 3.6. part no. FM-1657* pressure switch 14 bar and L-connector.

3.3 Electrical Activation*

As an alternative or complement to the manual activation with cables, the release valve can be actuated electrically. Fogmaker® has several different central units that can activate the electrical release. The release can be push button, semi-automatic, or fully automatic. The release is triggered by applying an electric voltage between 5-24 volts DC to the actuator. At the moment of activation the current is 3A (15W) during 1 millisecond. For a hydro pneumatic system there is also an electrically or manually activated “punch”* that cuts the tube. Contact Fogmaker® or your retailer for further information.

Section 4 Alarm Panels*

There are different alarm panels for fire and methane detection with optical or acoustical signals as well as special functions for automatic engine stop, release delay, fuel and main power cut-off. See figs. 4.1 – 4.4 and the Fogmaker® Fire and Methane Panel Manuals for more details.

Fig. 4.1 Alarm panel FM-6722-20*

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Fig. 4.2 Alarm panel fire only FM-US-400031* (surface mount) FM-US-400033* (in dash mount).

Fig 4.3 Alarm panel Fire & Methane detection FM-US-400018* (in dash mount).

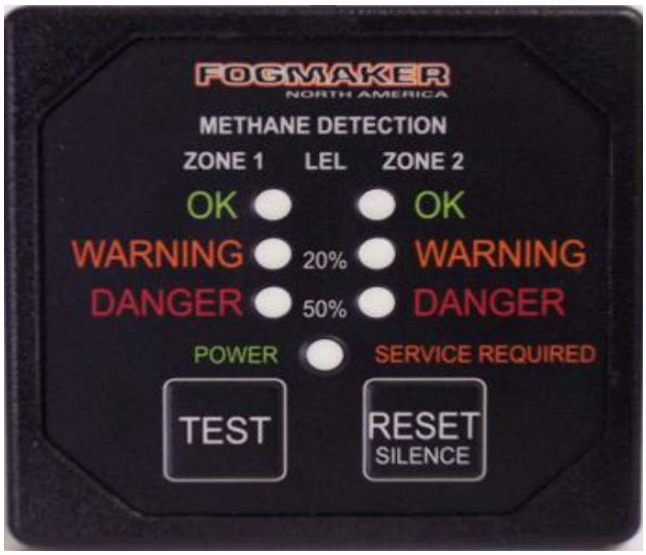
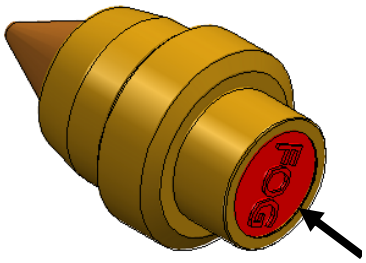


Fig. 4.4 Methane Detection Only Alarm Panel FM-US-400034*.

Section 5 Nozzles

The nozzles FM-1509-010 (0.8 L flow per minute) or FM-1503-010 (1.2 L flow per minute) consist of a body with built-in vortex generator and sintered filter. There is a hole in the end from which the water mist is sprayed. In order that the hole shall not become obstructed by contamination over time, disposable caps (part nos. FM-1505-3001 and FM-1505-014) are supplied that are to remain in place after the installation. Upon activation of the unit, the nozzle cap will be expelled by the pressure.

The nozzle spreads the water mist in a column-shaped mist with a diameter of approximately 500-600 mm and has a range of approximately 2000 mm. The nozzle cap is intended for single use and may not be reused. Replace with new caps as required.



Red cap is included with nozzle; replacement part number is FM-1505-3001.

Fig. 5.1 FM-1503-010 Nozzle with nozzle cap.

Yellow cap is included with nozzle; replacement part number is FM-1505-014.

Fig. 5.2 FM-1509-010 Nozzle with nozzle cap.

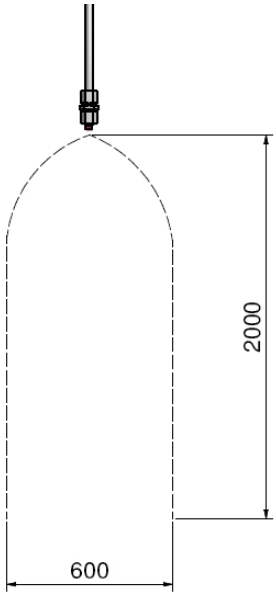


Fig. 5.3 Spreading of water mist.

Section 6 Hydraulic Hose

Between the piston accumulator and the pipe system or the bulkhead fitting, a hydraulic hose is connected that is intended to absorb vibrations and prevent vibration damage to the pipe lines. The hydraulic hose is available in any length with a straight-straight, straight-45°, or straight-90° connection nipple. Only hydraulic hoses supplied by Fogmaker® shall be used. **Only Fogmaker® hydraulic hoses of 5 feet in length and shorter are UL-listed.**

Fig. 6.1 Hydraulic hose, straight-90° connection nipple.

PART TWO: INSTALLATION

IMPORTANT SAFETY NOTES

Installation should only be done or reviewed by Fogmaker® authorized personnel.

For the systems with electrical* or mechanical actuation*, the testing of the activation function should be conducted on a completely assembled system. See Sections 9 and 10.
The final step to arm/activate the system is to remove the safety screw from the Release Valve. See Section 16 for details.

For the system with the hydro-pneumatic actuation the entire system should be fully installed, followed by the pressurizing of the detection system. See Section 11 for details.

After all checkups have been completed, the **final step to arm/activate the system is to remove the safety screw from the Release Valve. See Section 16 for details.**

Note that only components from Fogmaker® may be used. If other components are used, Fogmaker® will not guarantee the system function.

Use protective goggles for work with the Fogmaker® system.

Section 7 Installation of the Piston Accumulator

Install the container within no more than 26 ft/8 m of the space to be protected (no more than 26 ft/8 m from piston accumulator release valve to the first nozzle). The surroundings in the installation location should be clean and have a temperature of between -22°F to 149°F (-30°C to + 65°C), the same as the suppression unit. Do not locate the piston accumulator in the engine bay. Protection boxes are available in powder paint coated steel plate both for the single and double* piston accumulator. These are primarily used with external installations on vehicles/machines that operate in demanding environments. The protection boxes are also available in powder paint coated stainless versions.

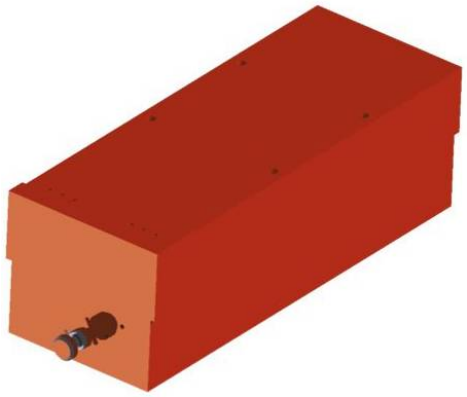


Fig 7.1 Protection box* for single PA.

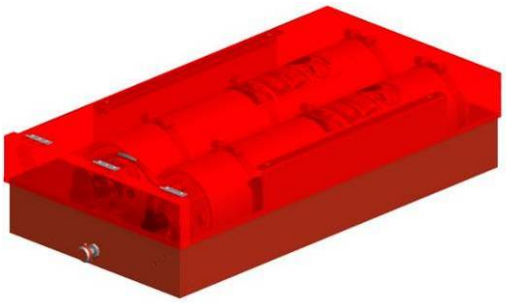


Fig 7.2 Protection box* for double PA*.

Mount the installation fittings in a suitable position on a sufficiently stable frame in order to withstand the weight of the cylinder/s. Use M8 x 25 mm bolts in the same number as there are attachment points on the single cylinder/double cylinder protecting boxes. Install the cylinder/s and protecting boxes so that there is a minimum of 6 in clearance at the end of the container where the release valve is located, and so that the space is sufficiently large to allow the connection of hydraulic hoses, pipes, detection hose, or release wires for mechanical activation or electric activation devices*. See Section 24 for weights of the cylinders and the protection boxes.

The container can be installed in any position. However, make sure to install the piston accumulator so that the gauge can be clearly read. (If the container cannot be installed with the gauge visible, it is recommended that a suppression unit with a pressure switch be used instead.) Do not use the pressure gauge attached to the fire suppression unit to determine when the intended charging pressure has been reached. Use a pressure regulator when the pressure source is a tank of high pressure gas; that is, gas at higher than the charging pressure of the unit.

7.1 Installation Dimensions (dimensions shown in millimeters)

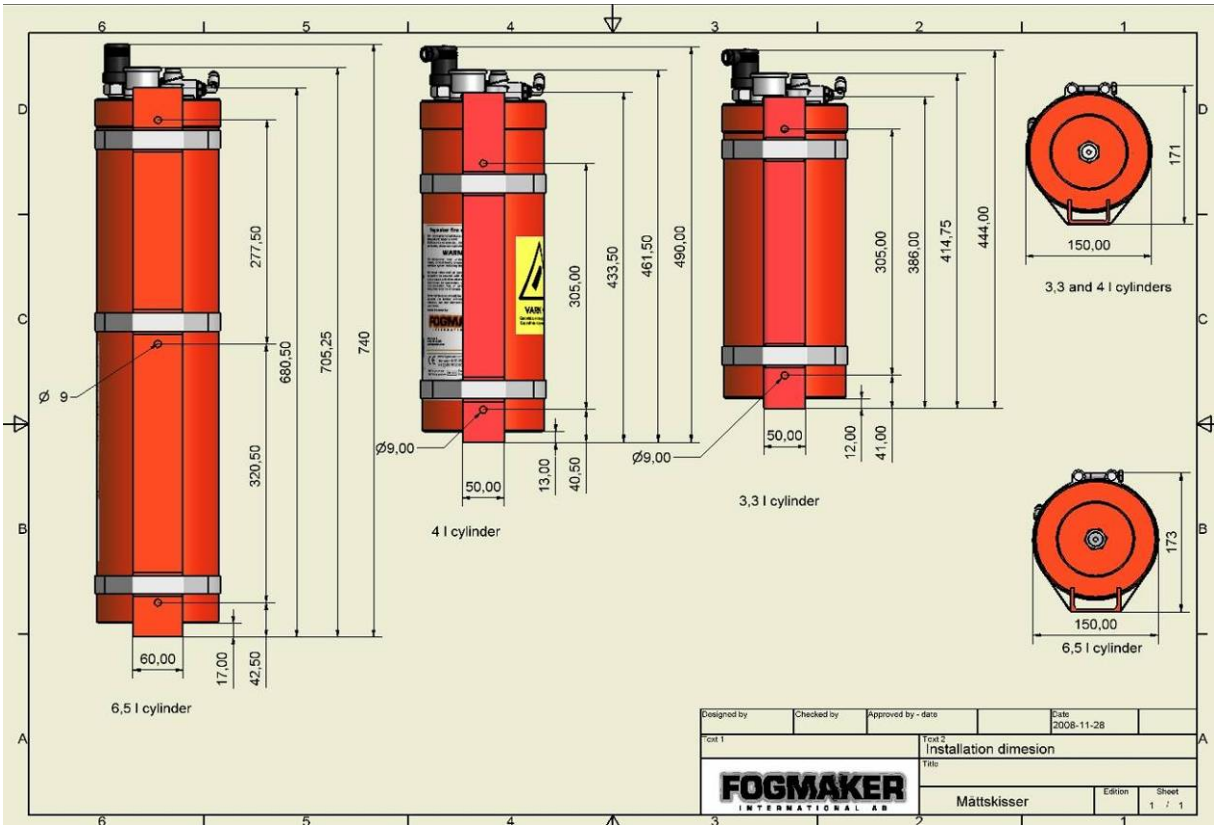


Fig 7.3 Installation dimensions 3.3 L*, 4 L and 6.5 L* single suppression unit.

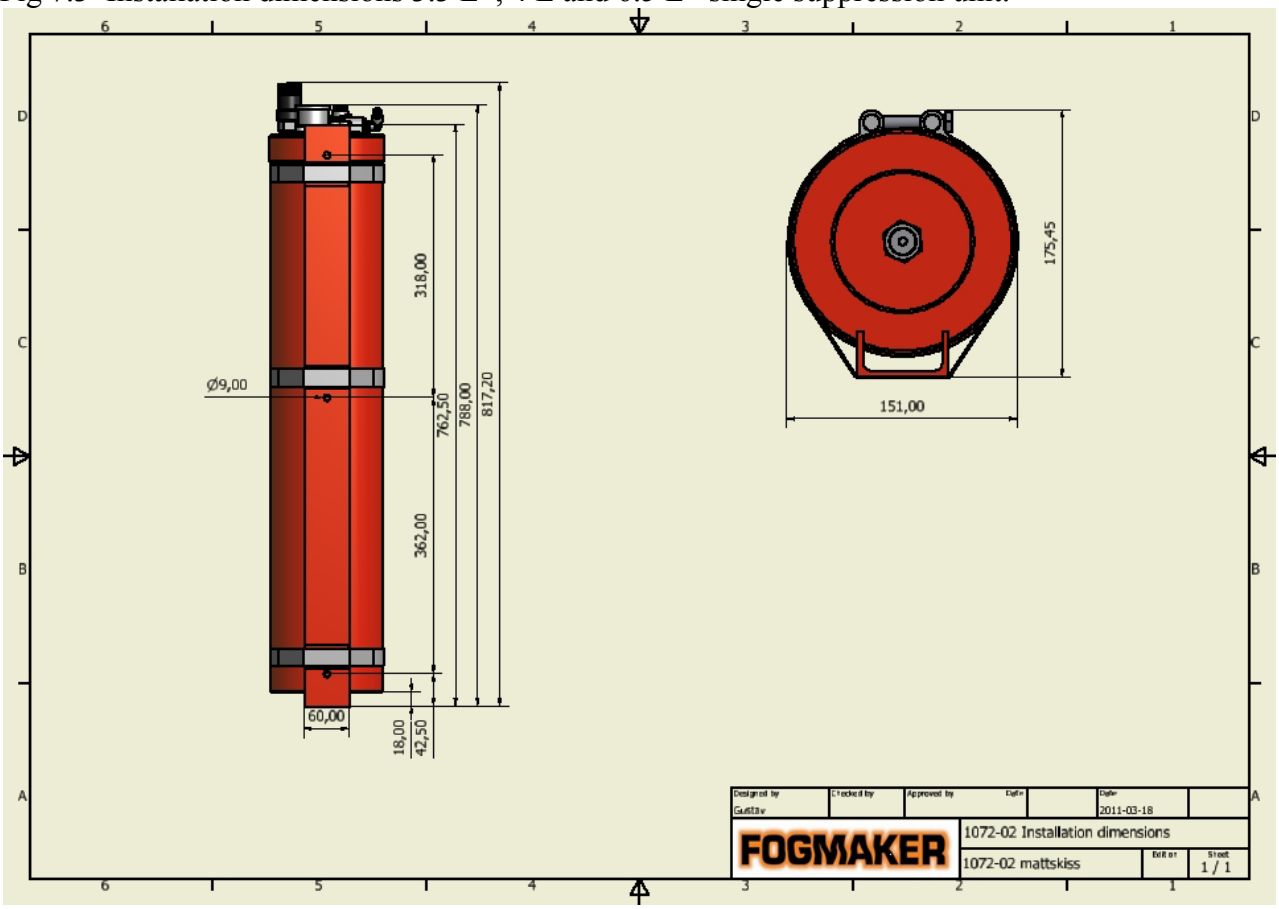


Fig 7.4 Installation dimensions 7.5 L single suppression unit.

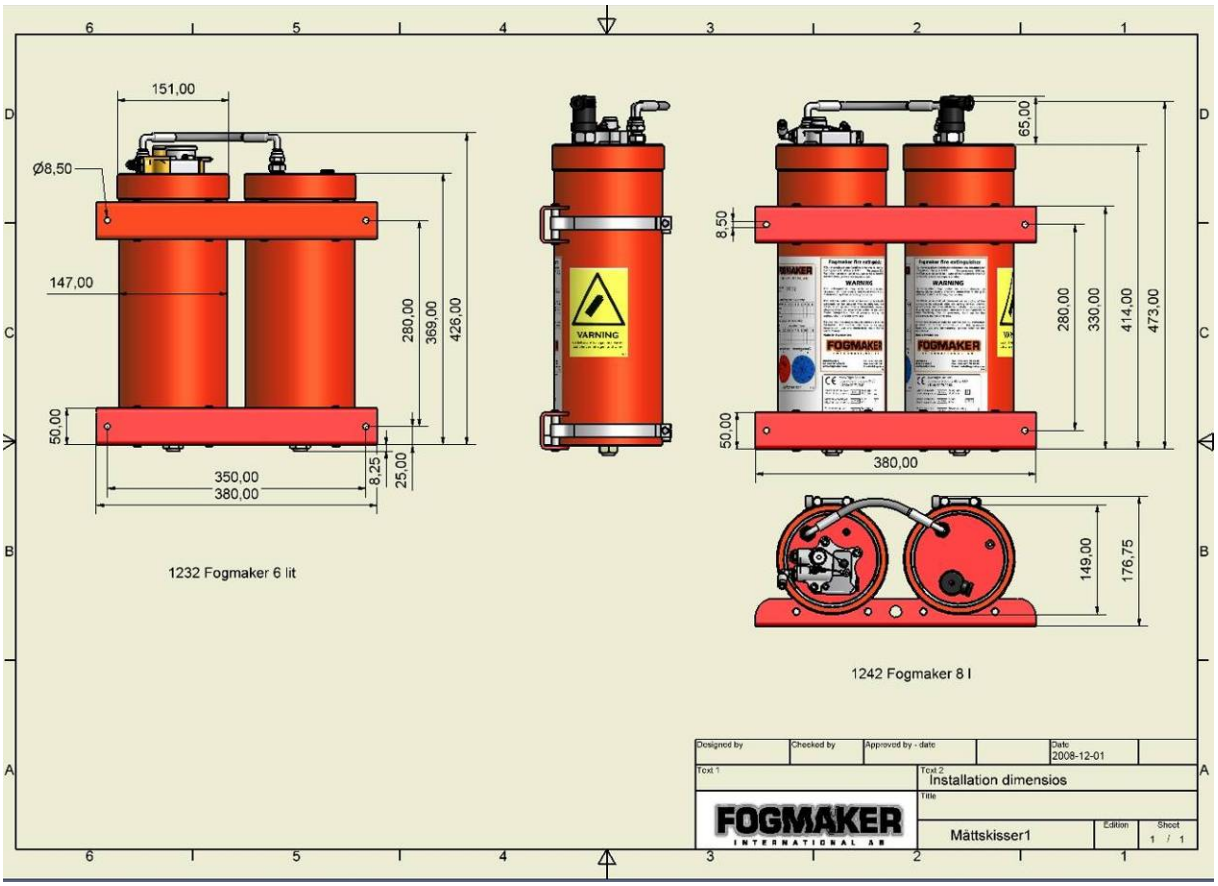


Fig 7.5 Installation dimensions 6 L* and 8 L* double suppression unit.

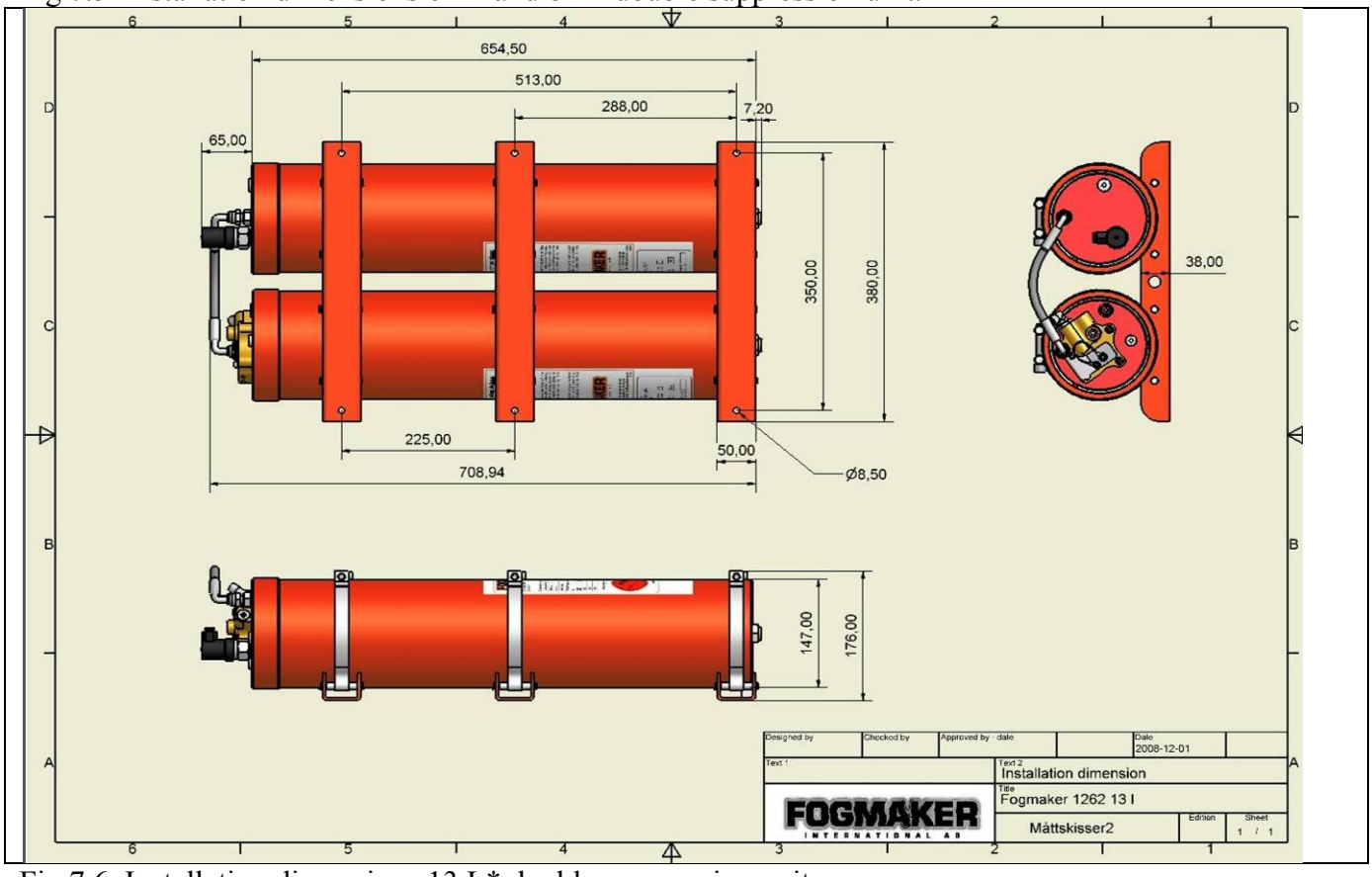


Fig 7.6 Installation dimensions 13 L* double suppression unit.

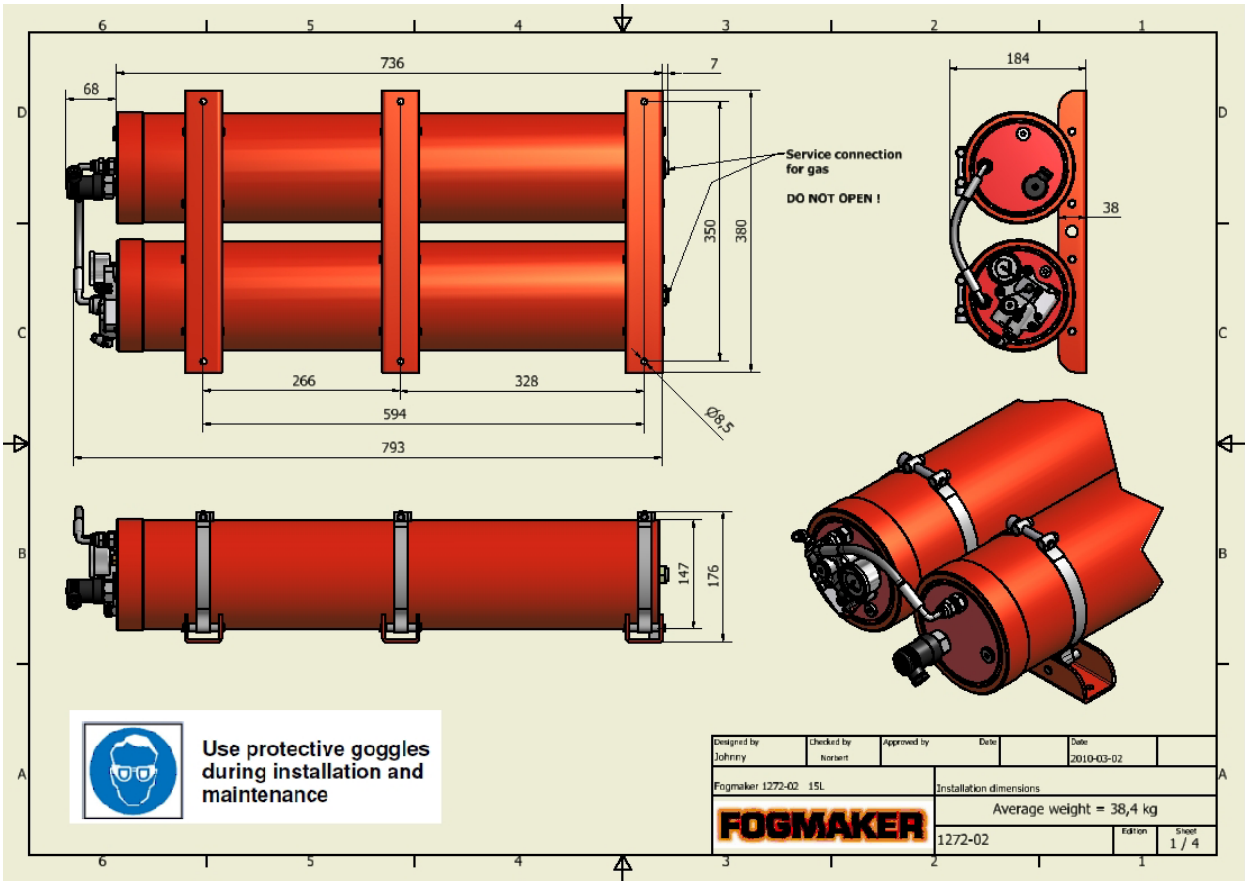


Fig 7.7 Installation dimensions 14 L* double suppression unit.

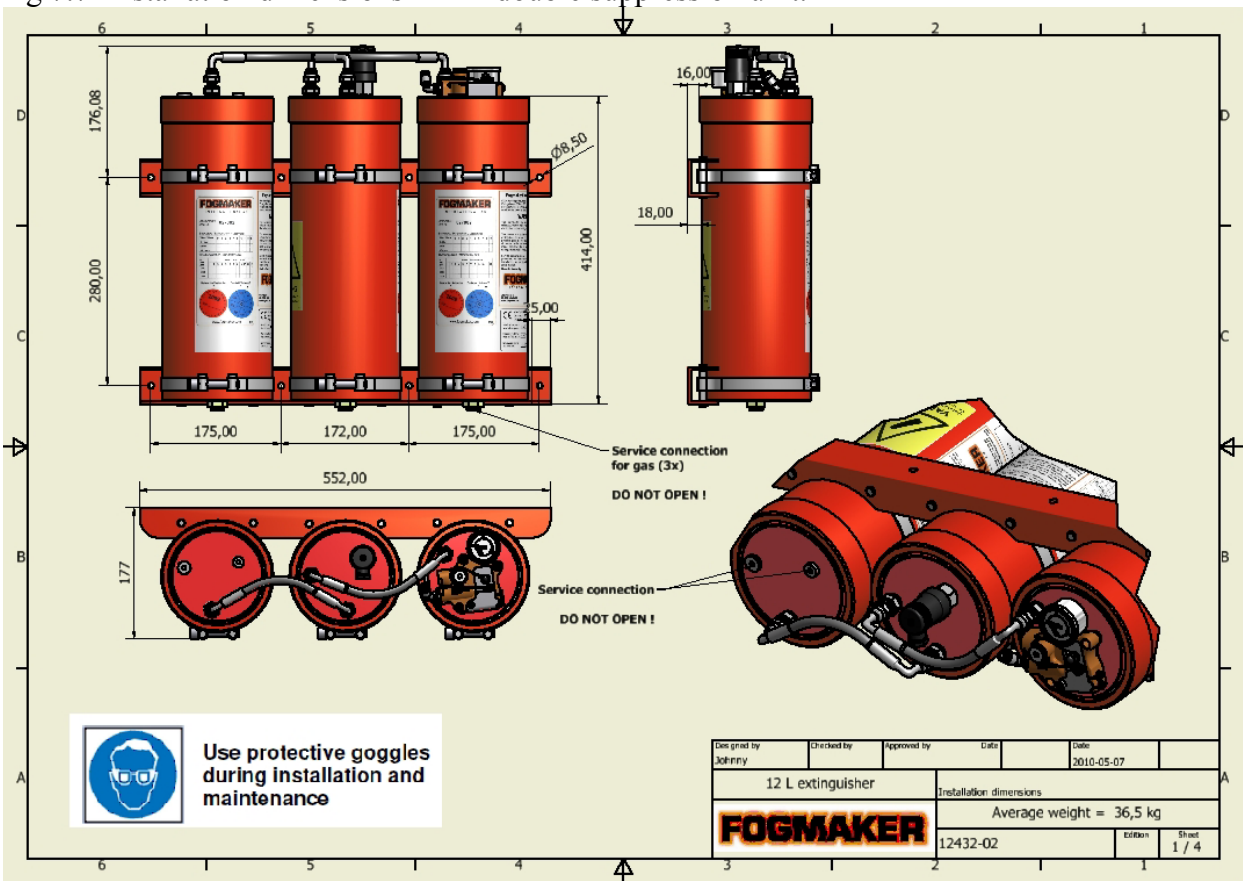


Fig 7.8 Installation dimensions 12 L* triple suppression unit.

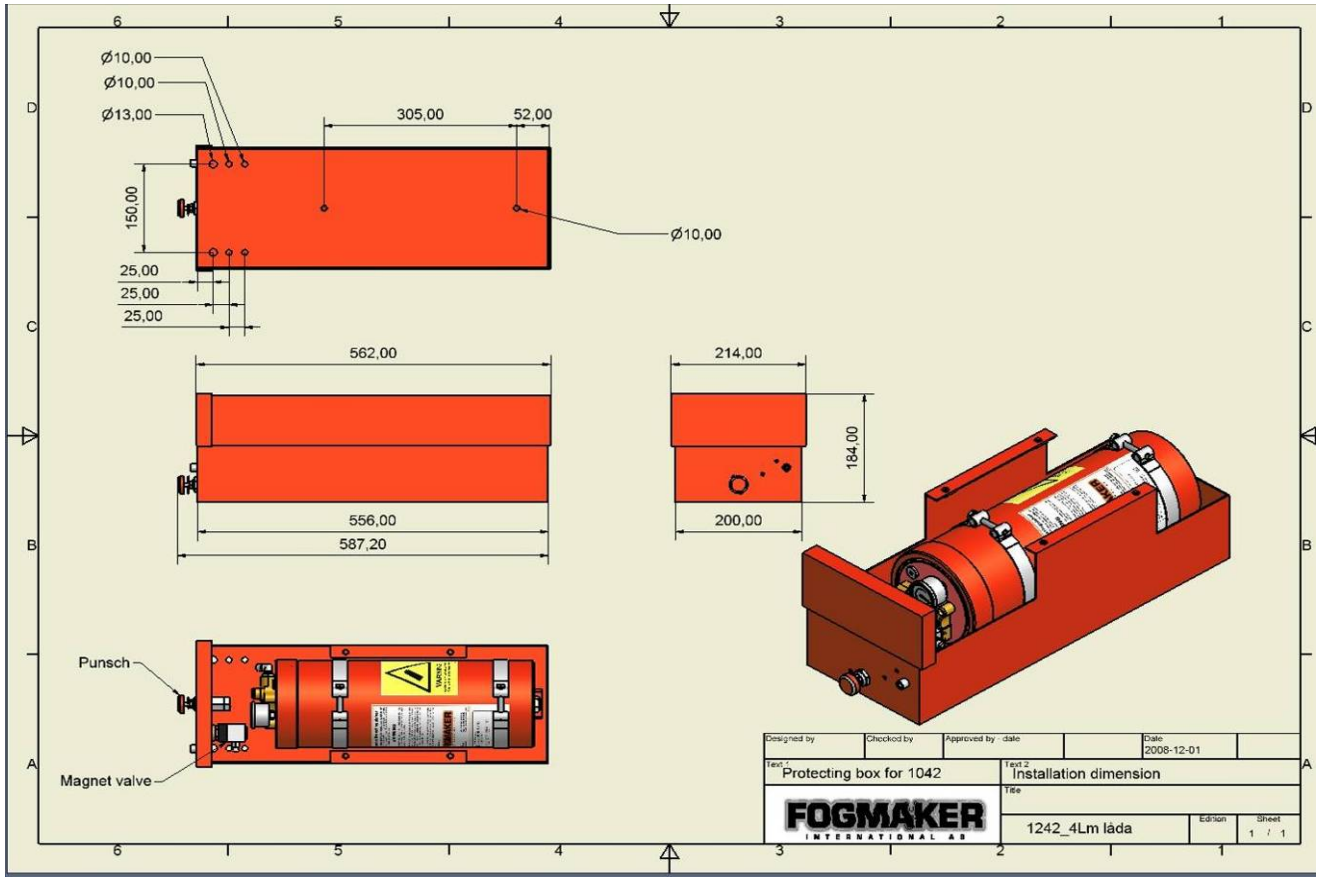


Fig 7.9 Installation dimensions 3.3 L* and 4 L single suppression unit in protection box*.

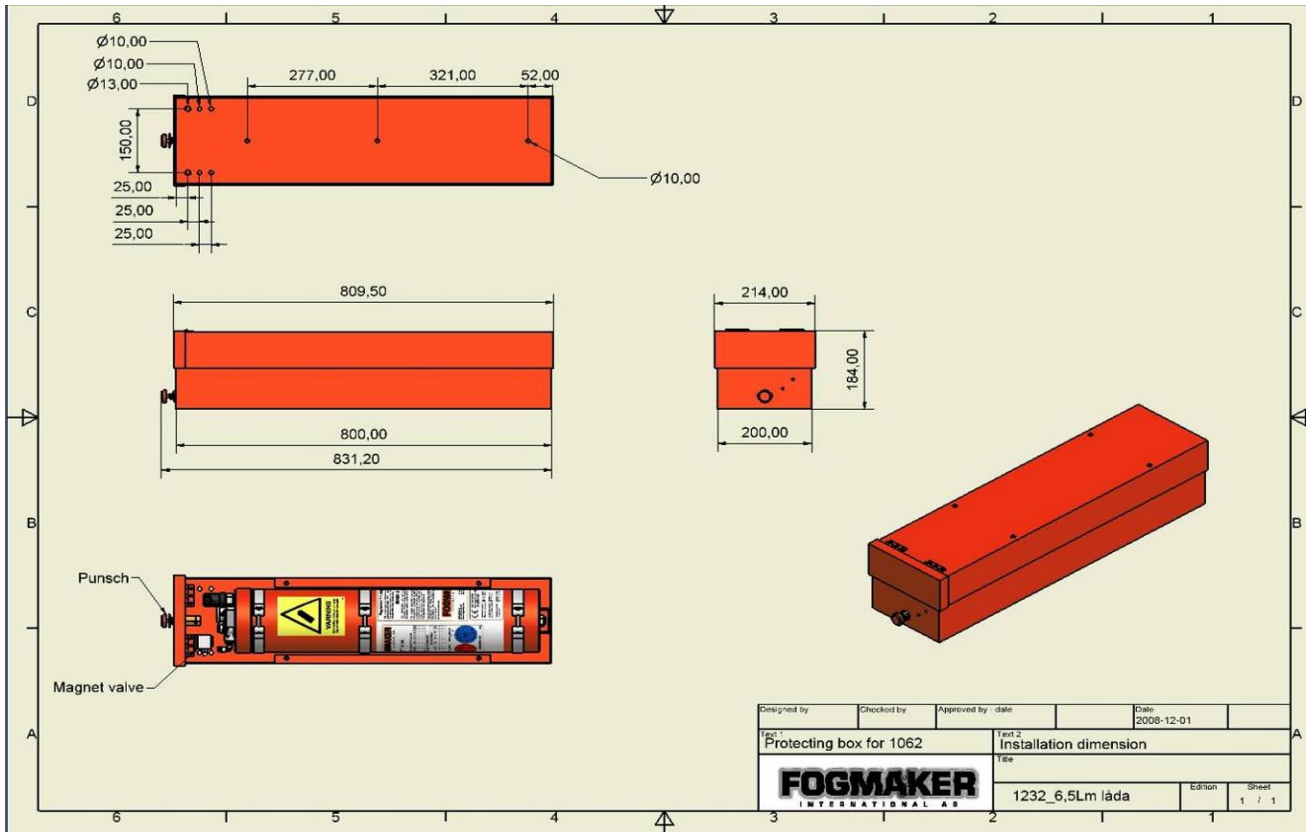


Fig 7.10 Installation dimensions 6.5 L* single suppression unit in protection box*.

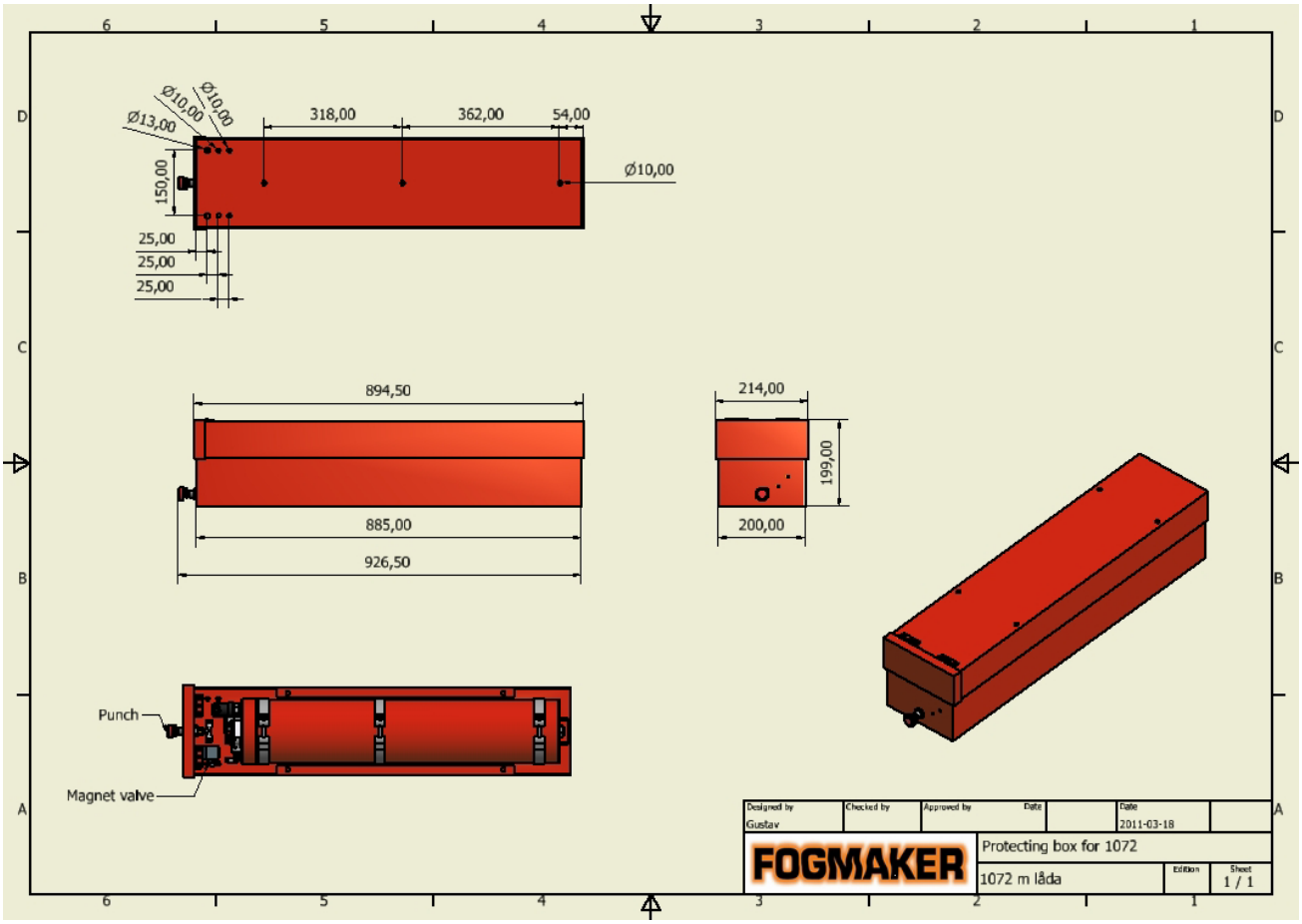


Fig 7.11 Installation dimensions 7.5 L single suppression unit with protection box*.

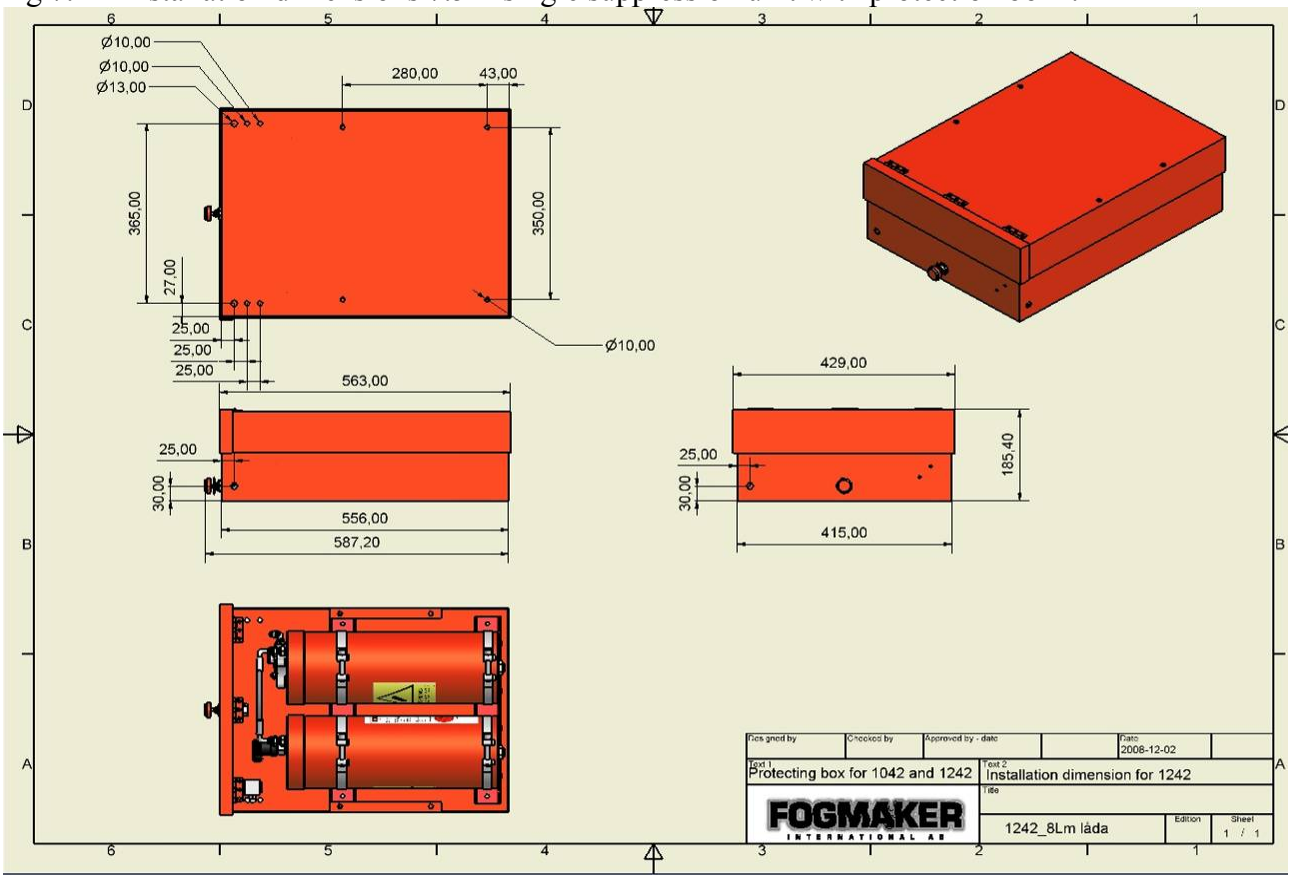


Fig 7.12 Installation dimensions 6 L* and 8 L* double suppression unit in protection box*.

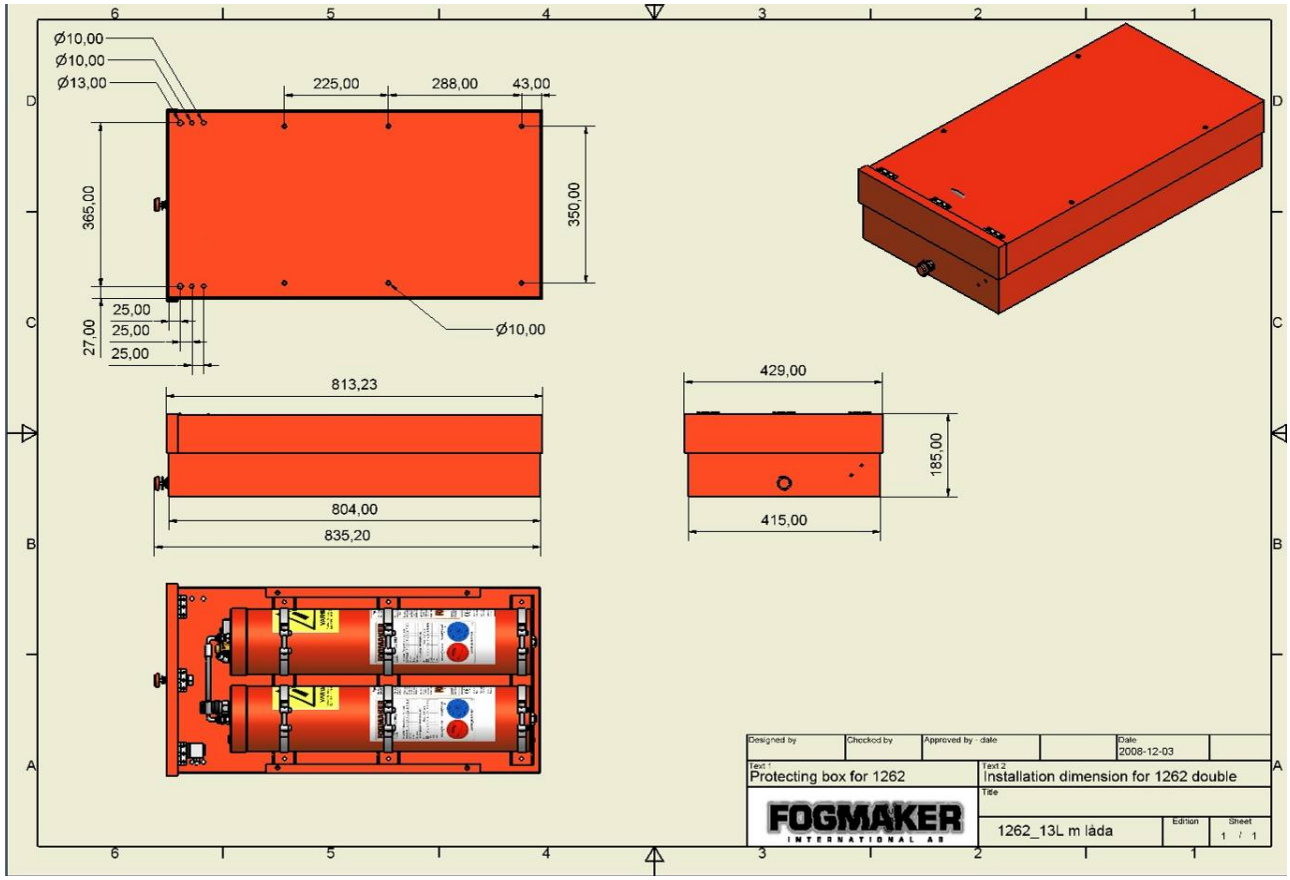


Fig 7.13 Installation dimensions 13L* double suppression unit in protection box*.

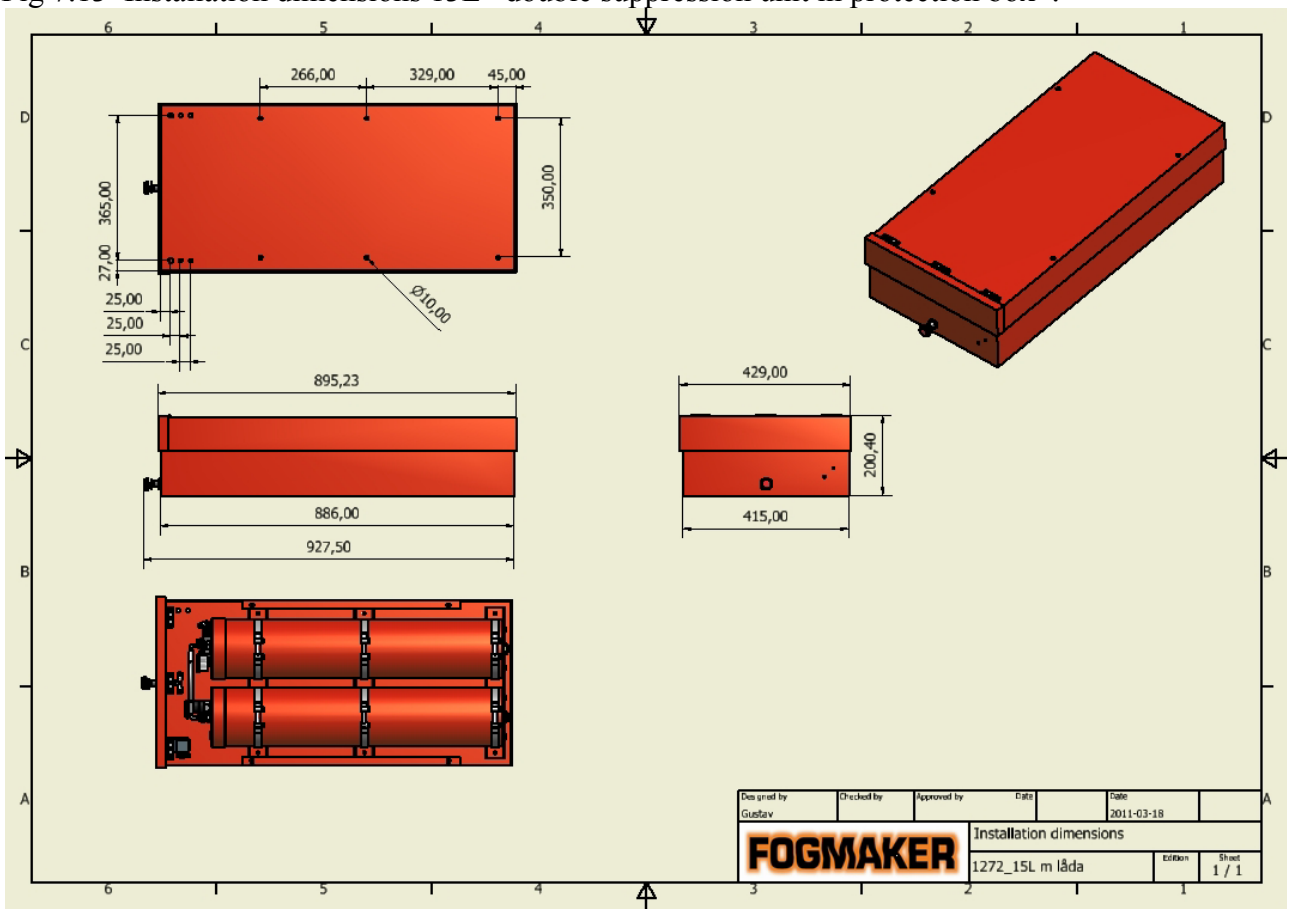


Fig 7.14 Installation dimensions 16 L* double suppression unit with protection box*.

Section 8 Installation of the Safety Screw Microswitch*

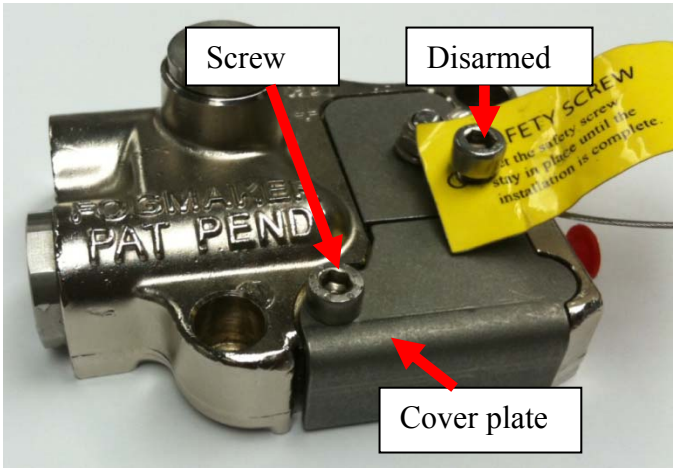


Fig. 8.1 Standard Release Valve.

1) Install safety screw in the disarmed location in the release valve before any work is done.
2) Remove and discard cover plate using a 4 mm hex key on the standard release valve (fig. 8.1). The screw will be reused with the microswitch assembly*.
3) Install the new microswitch assembly* (part no. FMWH-1117-001) onto the standard release valve with a 4 mm hex key (reuse the screw from step 1). See figs 8.2 and 8.3.

Fig. 8.2 FMWH-1117-001.

Fig. 8.3

4) Plug in the amp super seal connectors* between the wire harness and the 14 bar pressure switch on the detector bottle. Turn on the vehicle and check that the alarm panel* has the service light on when the safety screw is in the disarmed position.
5) Follow the arming instructions that are used after installation of the Fogmaker® system is complete (see Section 16). Only move the safety screw from the disarmed position to the armed position after the **ball valve is opened on the detector bottle.** See fig. 8.4 for the armed and disarmed locations.

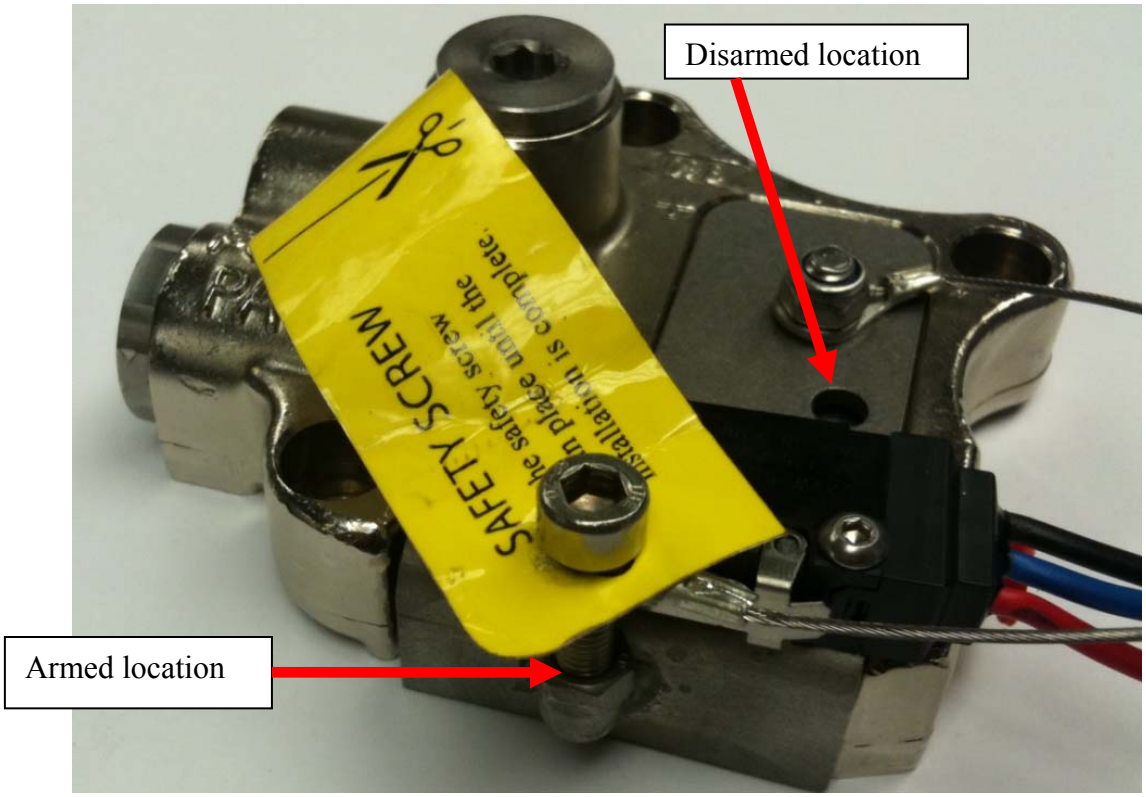


Fig. 8.4

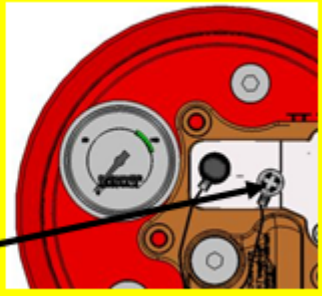
WARNING

The safety screw must always be installed during transport, installation, and service. When the safety screw and protection plate(s) are removed, Fogmaker® can be released unintentionally with only light pressure on the release catch under the protection plate. The release valve must not be removed when the container is pressurized. If the valve or any of its nipples or connectors are removed when the container is pressurized, a powerful fluid spray 943 psi (65 bar) can be emitted and cause serious personal injury.

Section 9 Installation of Mechanical Activation Cables*

NOTE

Confirm that the safety screw is installed in the release valve before installation and/or servicing of the piston accumulator to prevent unintentional discharge during installation.



In order to ensure a satisfactory cable function in the installation, proceed as follows:

- Drill an 8 mm hole where the handle will be located. Screw off the outer of the two M8 nuts and insert the cable fixture ”from the back”.
- Put on the safety lock, if one is to be installed, and then screw on the outer M8 nut again and tighten.
- Then tighten the M8 nut ”on the backside”.
- Install the supplied M5 nut and the T-handle on the cable.
- Lock the T-handle with the M5 nut in a suitable position.
  (It is particularly important, if the safety lock is used, to make sure that this can be opened/closed with suitable slackness.)
- Clamp the outer casing to the vehicle apart from the last half meter before the valve.
- The smallest bend radius for the cable is 150 mm.
- Remove the protection plate for the valve by loosening its screw (fig 9.2 no. 1).
- Pull out the inner cable from the casing with the help of the T-handle to about 120-150 mm and cut the outer casing to a suitable length.
- Pull out the cable again and install the terminals/tensioners (fig 9.2 no. 2) on the casing.
- Cut the inner wire to 26 and 31 mm respectively (fig 9.1) and thread the cable through the M6 hole in the valve housing and screw in the cable tensioner (fig 9.2 no. 2).
- Install the cable stops (fig 9.3 no. 5).
- Thread the cable stops in the cut tracks in the release catch (fig 9.4 no. 6).
- Attach the lid (fig 9.2 no. 4). The cable stops are kept in position by the lid.
- Install the last clamp as close to the valve housing as possible in order to ensure that the cable casing is properly fixed without any movement.
- Braces for the fixture of the cable should be located approximately 300 mm apart along the casing of the cable.
- Install the cable where it will not be exposed to breakage or acute bends that would prevent or impede activation.
- Fix or mount the pull handle on the end of the cable in an easily accessible position outside the space that the Fogmaker® unit is intended to protect in case of fire. For installation in vehicles, one of the handles is to be located in the operator/driver location and the other on the outside of the vehicle, in a place where it will not sustain physical damage from branches or other obstacles.

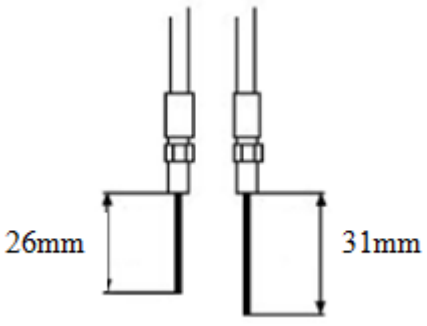


Fig. 9.1

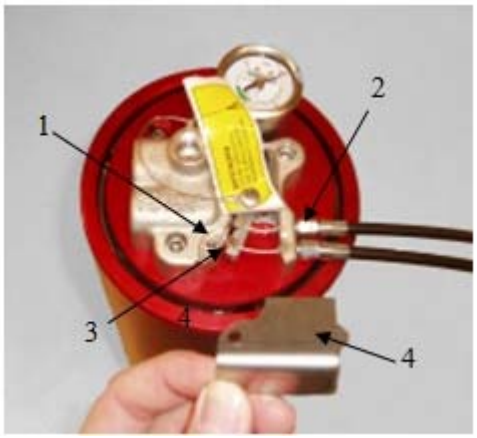


Fig. 9.2

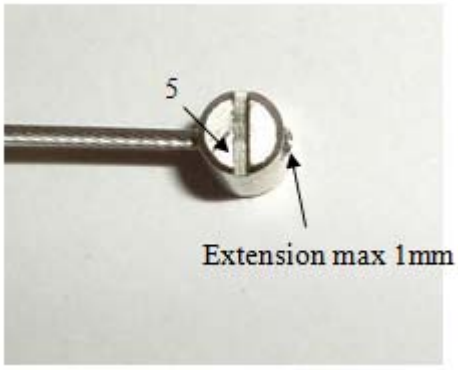


Fig. 9.3

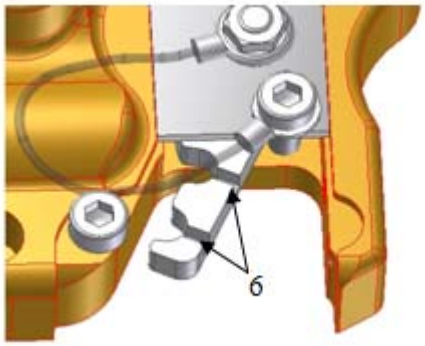


Fig. 9.4

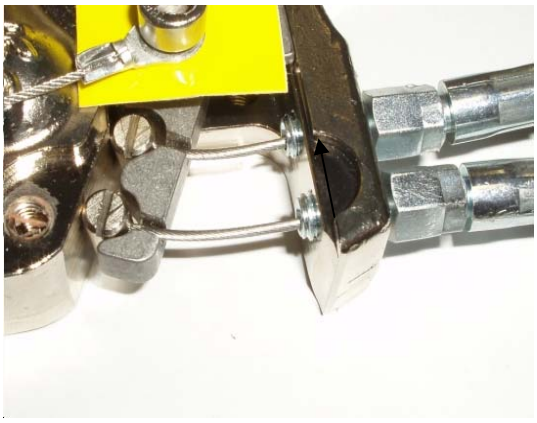


Fig. 9.5

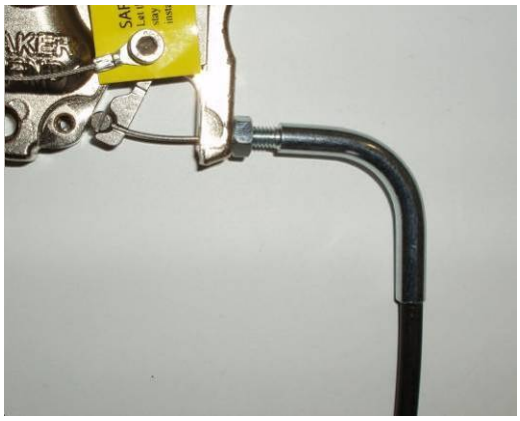


Fig. 9.6 In tight spaces a 90° angle bend can be used.

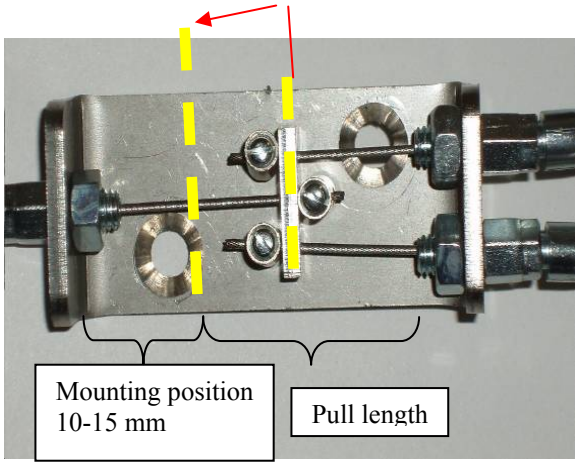


Fig. 9.7 If more than two cables are needed, a one to two cable split can be used.

- Assemble the cable split approximately 10-15 mm from the output on the valve.
- Check that the cable can stretch and is sufficient in order to trigger the valve.

- **Function testing of cable system after install is required. (Reference Service Manual section 2.1.)**

Section 10 Installation of Electrical Activation Switch*

Fig. 10.1 Push button switch kit*.

Mount the electrical activation switch* with the safety clip ring up. The safety clip should have the lanyard and tamper proof tie attached.

To test the switch:

NOTE: Do NOT check the switch function with the wire harness attached to the actuator. It will cause the actuator to function.

1. Disconnect the switch at the plug from the harness.
2. Remove the safety clip.
3. Check continuity accross the pins in the plug. It should be open. When the switch is pressed in, the continuity will be closed.
4. Reassemble the switch, putting the safety clip back in and securing with tamper proof tie. Be sure there is no continuity across the pins in the plug.
5. Attach the wire back to the harness at the plug.

Section 11 Installation of Hydro Pneumatic Detection System

The desired pressure in the detection system at 70°F/21°C after pressurization from the detection container is 20-24 bar. In order to obtain the desired pressure for different lengths of detection tubes, there are detection cylinders pressurized to 24 bar or 31 bar (see instructions below). In addition, the detection tube must be pre-filled with a hand pump if the tube length exceeds 14m*. Instruction for pre-filling is also shown below.

Under 8m	detection tube: 24bar detection container,	**no pre-filling.**
8m-14m	detection tube: 31bar detection container,	**no pre-filling.**
Over 14m	detection tube: 24bar detection container	**with pre-filling.**

See Section 15 for detection tubing limitations in UL-listed units.

11.1 Installation of Detection Tube

Heat rises, thus the detection tube must be installed in the upper part of the protected space. See figs. 11.1 and 11.2 for possible system designs. Fogmaker® hydro pneumatic detection tubing is part no. FM-40380.

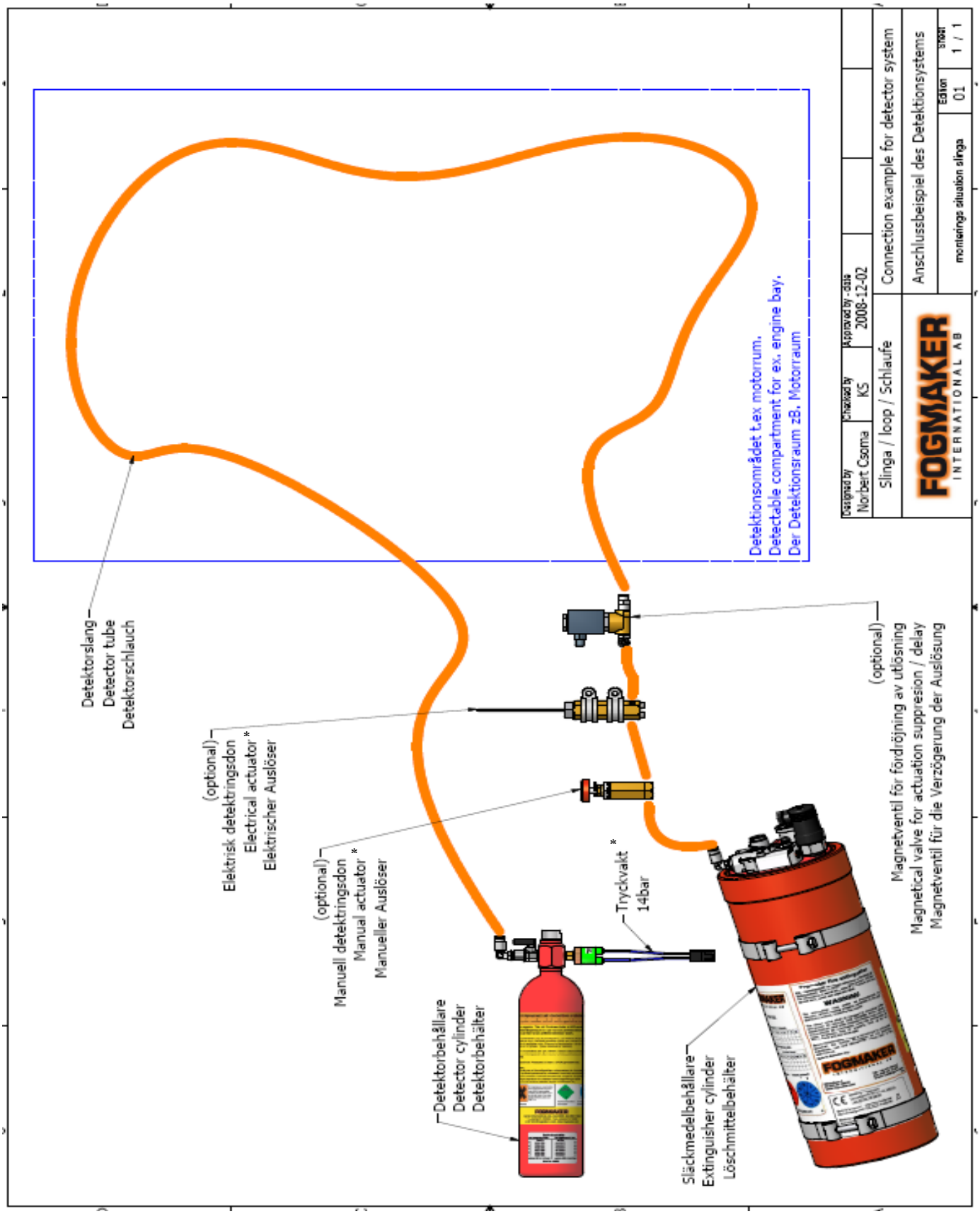


Fig. 11.1 Example of Detection System Design.

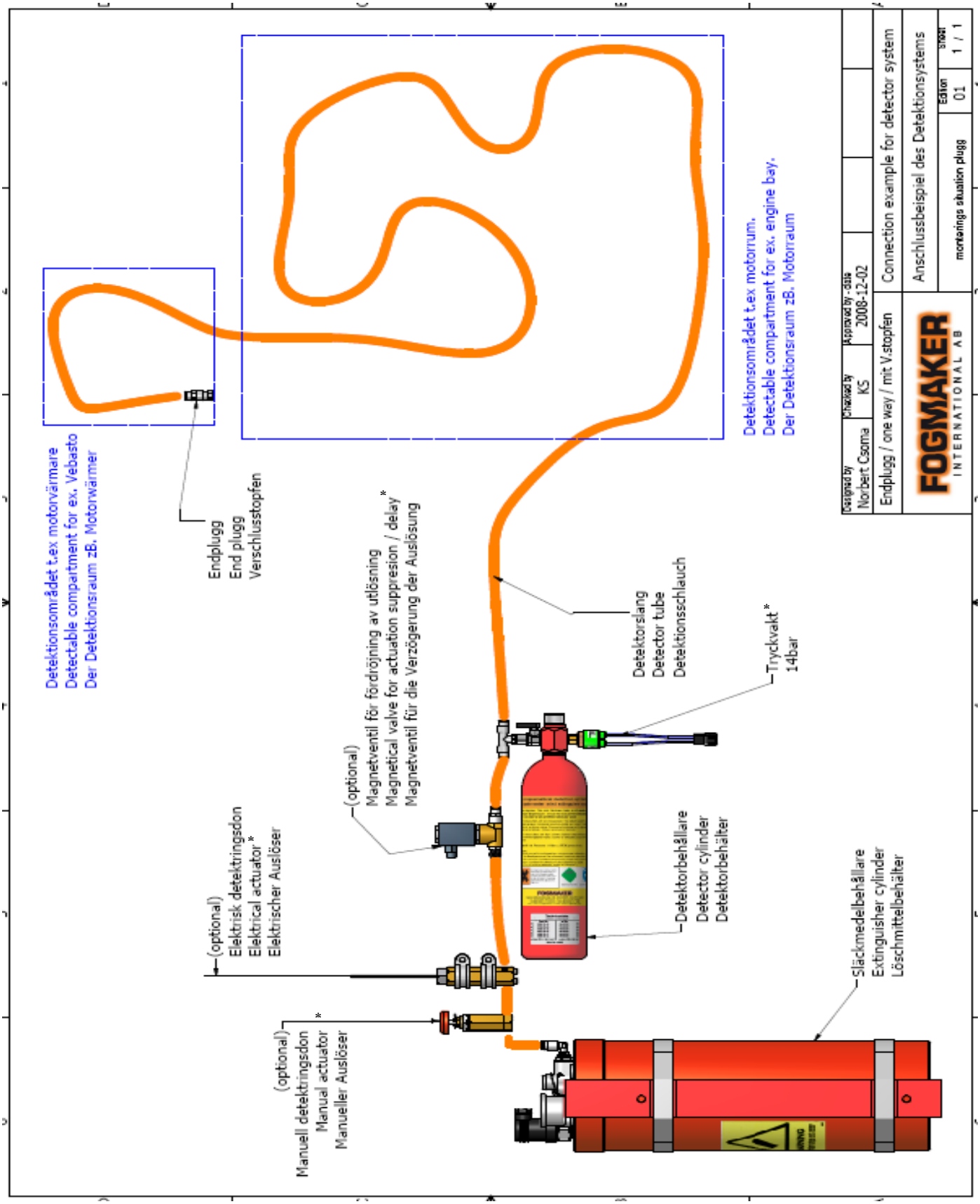


Fig. 11.2 Example of Detection System Design.

Item #1

Locate the detection tube end plug (fused) in a cool area and fasten it with a 12 mm steel-rubber brace.

Item # 2

Refer to fig. 11.4 for preferred method to transition from protection conduit* to coil.

Item # 3

Refer to figs. 11.6 and 11.7 for suggested methods to mount the detection tube.

Fig. 11.3 End of Protective Coil (Example A).

Fig. 11.4 End of Protective coil (Example B).

ALWAYS bend the cut coil ends as shown above.

Instruction for fastening of detection tube onto pipe

Fig. 11.5 Incorrect positioning.

Avoid the above situation by mounting correctly in order to eliminate the risk of changes in position by vibrations, heat, etc.

Fig. 11.6 Example of fastening detection tube onto pipe.

Fig. 11.7 Example of ideal method of fastening detection tube onto pipe.

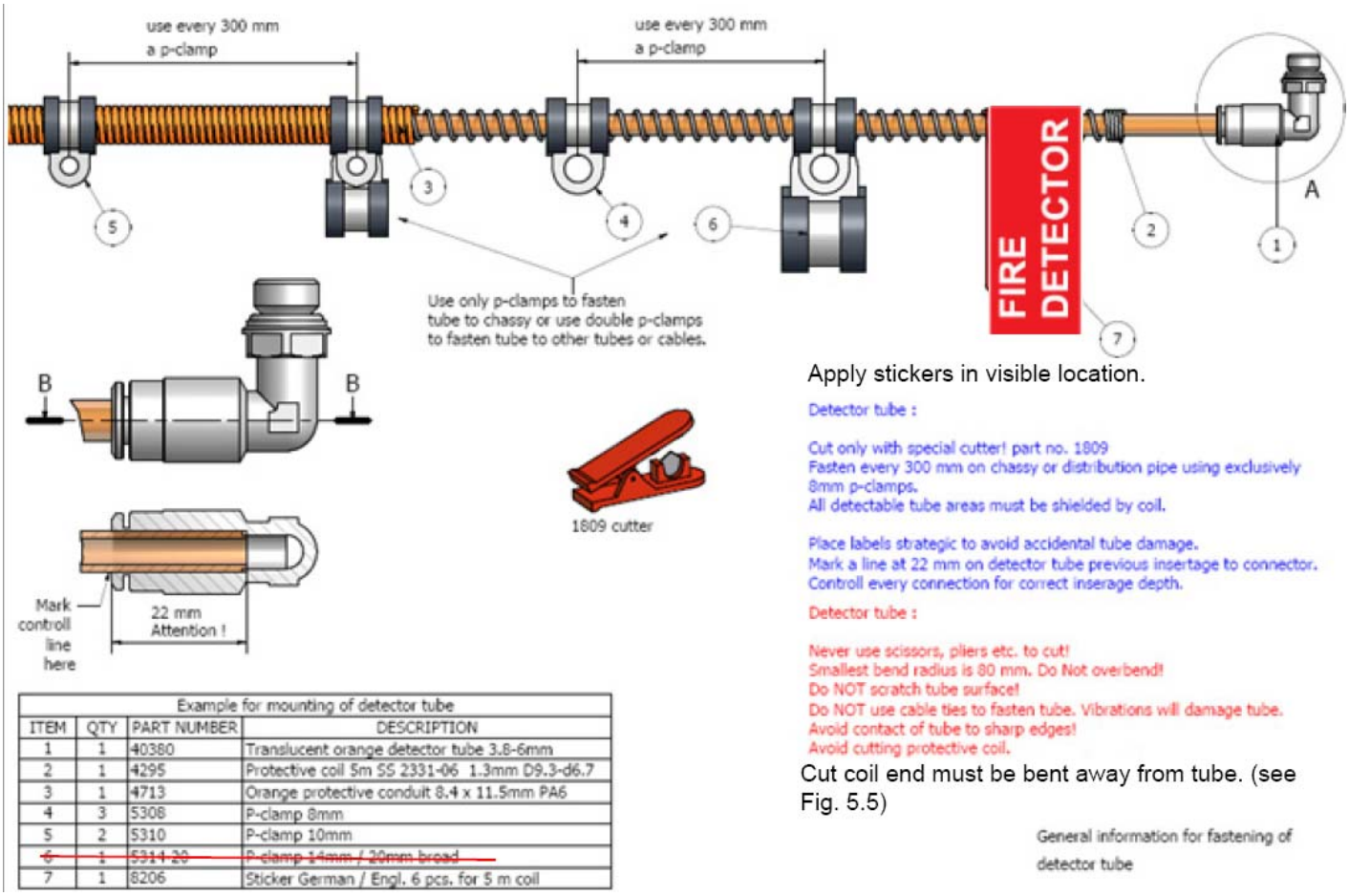
Avoid locating the detection tube near sharp edges and do not bend it less than a radius of 3.15 in (80 mm). Avoid a location close to heat sources such as turbochargers, etc. High temperatures affect the material structure of the detection tube and can degrade the tube and cause faulty detection.

The minimum distance between the detection tube and a turbo, manifold, silencer, catalyzer, or other hot part is 20 in (500 mm). The detection tube should be easy to remove and visually inspect for service. The detection tube is provided with labels (see fig. 11.8, item 7) that indicate the purpose of the tube.

On the entire detective length of the detection tube (i.e., in the protected area), a stainless protection coil must be used. Protection coils are available in four lengths: 4.5m, 5m, 6m and 7m. Avoid cutting the protection coil. If the coil must be cut, the end of it must be bent into a ring (∞ shape) away from the tube to avoid scoring (see figs. 11.3 and 11.4).

Use 8 mm steel-rubber braces when installing the detection tube in the protected space. If wire ties must be used, they should be at least 10 mm wide. **The wire ties must not be applied directly on the detection tube.** **Use a minimum 50 mm layer of protection conduit (part no. FM-47132*) in between.**

Outside the protected space, use conduit (protection) tube* in order to protect the detection tube over its entire length. Fasten with 10 mm steel-rubber braces or, in exceptional cases, use the aforementioned wire ties.



Example for mounting of detector tube

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	40380	Translucent orange detector tube 3.8-6mm
2	1	4295	Protective coil 5m SS 2331-06 1.3mm D9.3-d6.7
3	1	4713	Orange protective conduit 8.4 x 11.5mm PA6
4	3	5308	P-clamp 8mm
5	2	5310	P-clamp 10mm
~~6~~	~~1~~	~~5314-20~~	~~P-clamp 14mm / 20mm broad~~
7	1	8206	Sticker German / Engl. 6 pcs. for 5 m coil

Fig. 11.8 Installation of detection tube.

11.2 Pressurizing of the Detection Tube

For detection tube less than 14 meters:

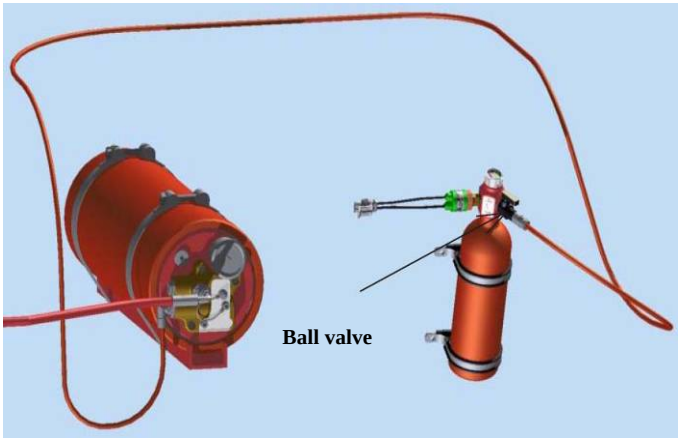


Fig. 11.9

- Pressurize the detection tube by slowly opening the ball valve on the detection bottle.
- The detection fluid will fill the detector tube.
- The fluid is colored to make it visible in the tube. There will be an air bubble in the end of the tube.
- This air bubble will disappear slowly over several weeks and pressure will drop about 0.5 bar.
- Final pressure in the fire detection system should be between 20 and 24 bar on the gauge.

For detection tubing longer than 14 meters*:

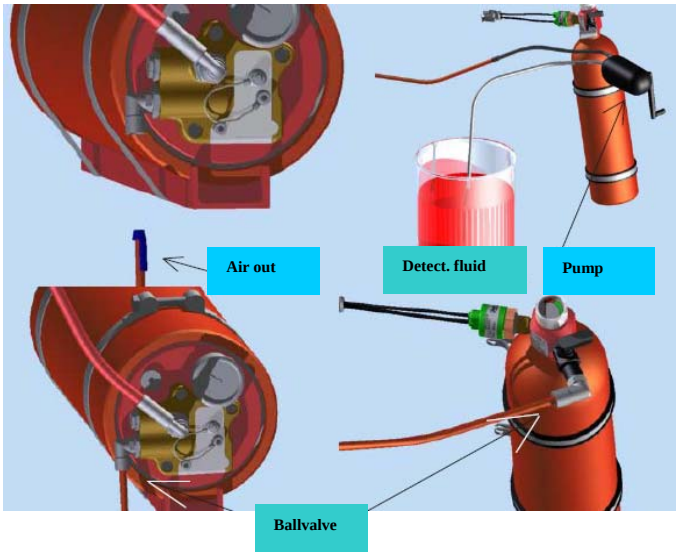


Fig. 11.10

- Fill the detection tube with accompanying detection fluid, using the Fogmaker® detector fluid pump.
- Fill first the pump with fluid by submersing both suction and pressure hose into detection fluid during rotating the pump handle.
- Then attach the pressure hose of the pump to the detection tube.
- Fill the detection tube until detection fluid comes out the other end to ensure that all air is gone.
- Install tube end into the piston accumulator or end plug.
- Pressurize the detection tube. **Slowly** open the ball valve mounted on the detection cylinder.
- Final pressure in the fire detection system should be between 20 and 24 bar.

11.3 Detection Cylinder

Enclosed with the detection cylinder on delivery are two braces, four to six labels, and fitting contacting parts for the AMP-contact on the pressure switch. Use an Elpress DRB 115 or similar crimping tool.

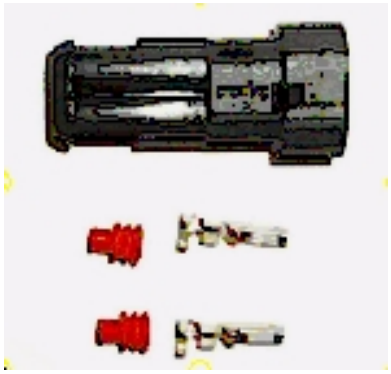


Fig. 11.11 Parts for the AMP super seal contact.

Fig. 11.12 Tong Elpress DRB 115.

The detection container must be installed in one of the approved positions shown in fig. 11.13. Inside all detection containers is a flexible siphon tube that will not operate properly if installation deviates from the ideal or OK positions shown below.

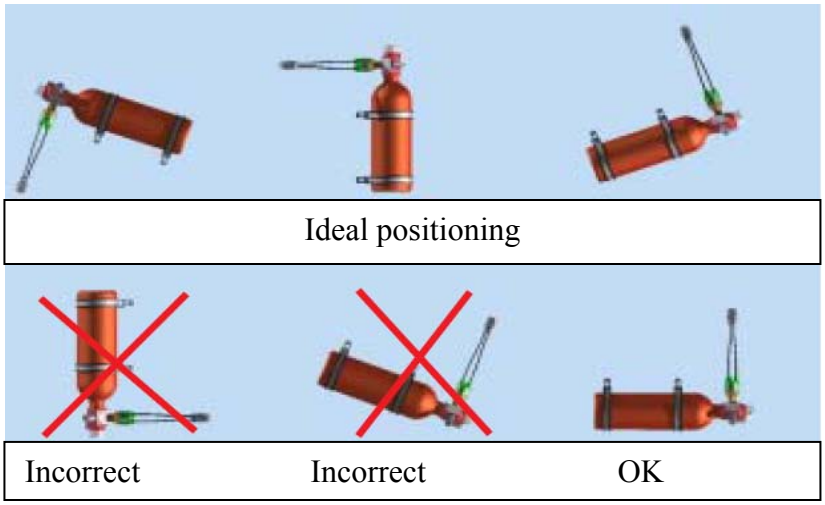


Fig. 11.13 Detection cylinder mounting positions.

11.4 Signal Processing from the Pressure Switch*

If pressure switches are connected to one of Fogmaker's® alarm panels, the handling is managed automatically. Refer to Alarm Panel Manuals for connections.

If the pressure switch is connected to an existing system, CAN bus – multiplexer, the signals shall be interpreted as in the tables below.

System with 2 pressure switches* on the detection container and without a pressure switch on the piston accumulator.

Standard pressure switch **14 bar**	Optional pressure switch* **5 bar**	Evaluation of signal
On the detection container	On the detection container	
0	***1***	Pressure loss in detection system
1	***0***	Pressure switch 5 bar faulty, or wire disruption
0	***0***	FIRE
1	***1***	System OK

System with 2 pressure switches* on the detection container and with a pressure switch on the piston accumulator.

Standard pressure switch **14 bar**	Optional pressure switch **5 bar***	Optional Pressure switch **50 bar***	Evaluation of signal
On the detection container	On the detection Container	On the piston accumulator	
0	***1***	***1***	Pressure loss in detection system
1	***0***	***1***	Pressure switch 5 bar faulty, or wire disruption
1	***1***	***0***	Pressure loss in the piston accumulator or released
0	***0***	***0***	FIRE
1	***0***	***0***	FIRE
0	***1***	***0***	FIRE
1	***1***	***1***	System OK

Systems with 1 pressure switch* on the detection container and with a pressure switch* on the piston accumulator.

Standard pressure switch **14 bar**	Optional Pressure switch **50 bar***	Evaluation of signal
On the detection container	On the piston accumulator	
0	***1***	Pressure loss in detection system
1	***0***	Pressure loss in the piston accumulator or released
0	***0***	FIRE
1	***1***	System OK

Fig. 11.14

11.5 Attachment of the Detection Tube to the Connectors

The connectors are specially produced to cope with the tough system requirements. These are equipped with 3 O-rings and withstand high pressures and temperatures.

A cut end on the detection tube must be clean, undamaged, round, and free from scoring. In order to ensure that the detection tube is in contact with the bottom of the connector, mark a control line at 22 mm from the cut end with a black felt-tip pen or tape. The insertion depth must be a minimum of 20 mm. When installing the detection tube in the connector, hold the connector firmly and wiggle the tube at the same time as you push it in.

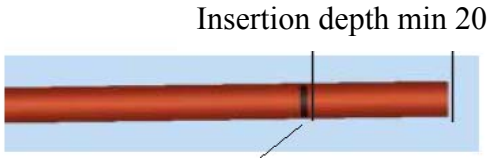


Fig. 11.15 Positioning of control line.

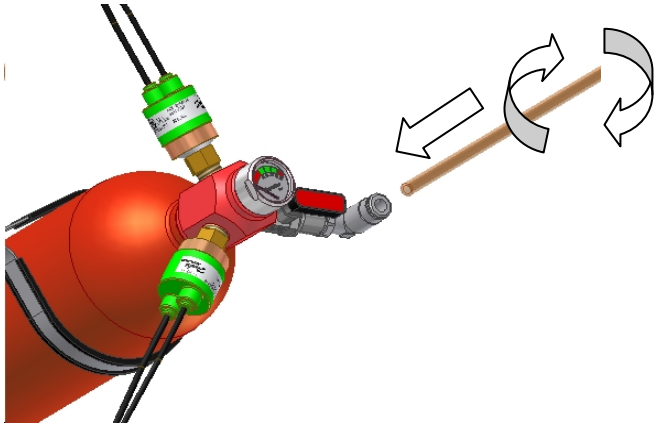
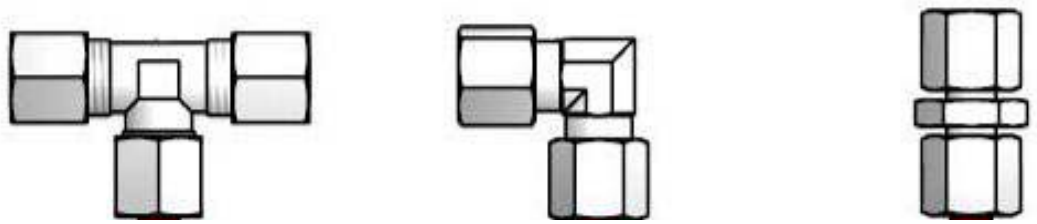


Fig. 11.16 Insertion of detection tube.

The tightness of the detection system must be checked for fluid leakage after the ball valve on the detection container has been opened. Inspect every connection and follow the whole path of the detection tube. Note the gauge value and check again after approximately 15 minutes to ensure it is still in the green swept area.

Section 12 Installation of Nozzles

The nozzles are installed with a T-connection, part no. FM-4401, straight connector, part no. FM-4402, or 90-degree elbow, part no. FM-4409 without a cutting ring. See section 15 for details on nozzle limitations for UL-listed units.



FM-4401 FM-4409 FM-4402

Fig. 12.1 Fittings/Connectors.

Mounting Nozzles

Before installation, make sure that the nozzles are clean and that they have no visible defects. It is preferred to use a premounting tool for connections; if not available, a vise can be used to hold the connection in place.

- Remove the nut and cutting ring. The cutting ring will not be used.
- Place the nozzle in the nut and screw the nut back on the connection as far as possible by hand.
- Tighten with spanner ½-1 turns, approximately 20 Nm, then loosen the nut and tighten ½ turn after the noticeable increase in torque.

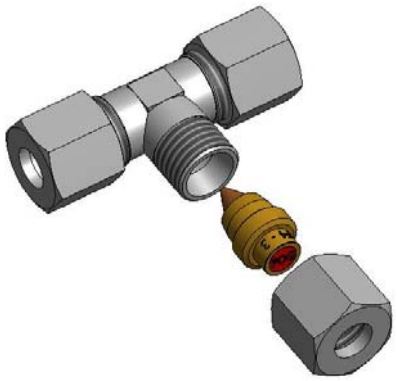


Fig. 12.2 Mounting nozzles.

Nozzle Quantities and Placement for UL-Listed Units

The 4L piston accumulator is UL listed for use with 3 to 4 1.2L flow per minute nozzles or 4 to 6 0.8L flow per minute nozzles. The 7.5L piston accumulator is UL listed for use with 6 to 9 1.2L flow per minute nozzles or 8 to 14 0.8L flow per minute nozzles. Nozzles must be placed in a manner that complies with the minimum and maximum nozzle spacing, as well as the minimum and maximum perpendicular distance to the side wall as shown in the table below.

PA Size in L	NozzleType, liter flow per minute	Number of Nozzles	*Maximum Nozzle Spacing, in.	*Minumum Nozzle Spacing, in.	**Maximum Perpendicular Distance to Side Wall, in.	**Minimum Perpendicular Distance to Side Wall, in.
4	1.2	3	32	23.5	12	7
4	0.8 or 1.2	4	19	17	17	9
4	0.8	5 or 6	28	12	13	9
7.5	1.2	6 or 7	28	12	13	9
7.5	0.8	8 to 14	18	9	11	8
7.5	1.2	8 or 9	18	9	11	8

* For units with more than 3 nozzles, the minimum and maximum nozzle spacing applies to the closest 2 nozzles.
** For units with more than 4 nozzles, where centrally placed nozzles are anticipated, the maximum perpendicular distance requirement only applies to the nozzles closest to the side walls.

Section 13 Installation of Pipe Systems

Stainless steel pipes 8x1mm, part no. FM-4008-115, are the only pipes that may be used in a Fogmaker® fire suppression unit. Only pipes supplied by Fogmaker® may be used. The stainless pipes are 45 in (1150 mm) in length, so keep this in mind when engineering a system. The pipes should be bent using a 24 mm radius on a CNC bender, table top bender, or hand bender. NEVER bend pipe freehand, as this can cause kinks and duplication issues. Keep a minimum straight length between bends of .75 in (19 mm). Keep a .75 in (19 mm) straight on tube ends to ensure cone sealing when inserted into fittings. If the pipe system for a certain application must be movable, or if piping is very difficult to install, hydraulic hoses can be used instead (see Section 14). Try to minimize the use of hydraulic hose. See Section 15 for details on the pipe system limitations for UL-listed units.

Install the pipe system with the nozzles in the roof of the space to be protected. Make sure that it is possible to install the pipe system so that it is located firmly. The nozzles shall be inclined slightly inwards and downwards, 300-500 mm from the engine and with 700-900 mm distance between the nozzles in order to achieve the best possible spreading of the flow. See fig. 13.1.

The suppressing effect is improved when the nozzles are directed towards the parts of the space where fire can be expected to arise or some hot area that speeds up the steam formation. Examples of such hot parts are spray pipes, turbo, manifolds, compressors, and additional heaters. The spray from different nozzles should be adjusted so that it does not disrupt the spray from other nozzles and then disrupt the mist formation.

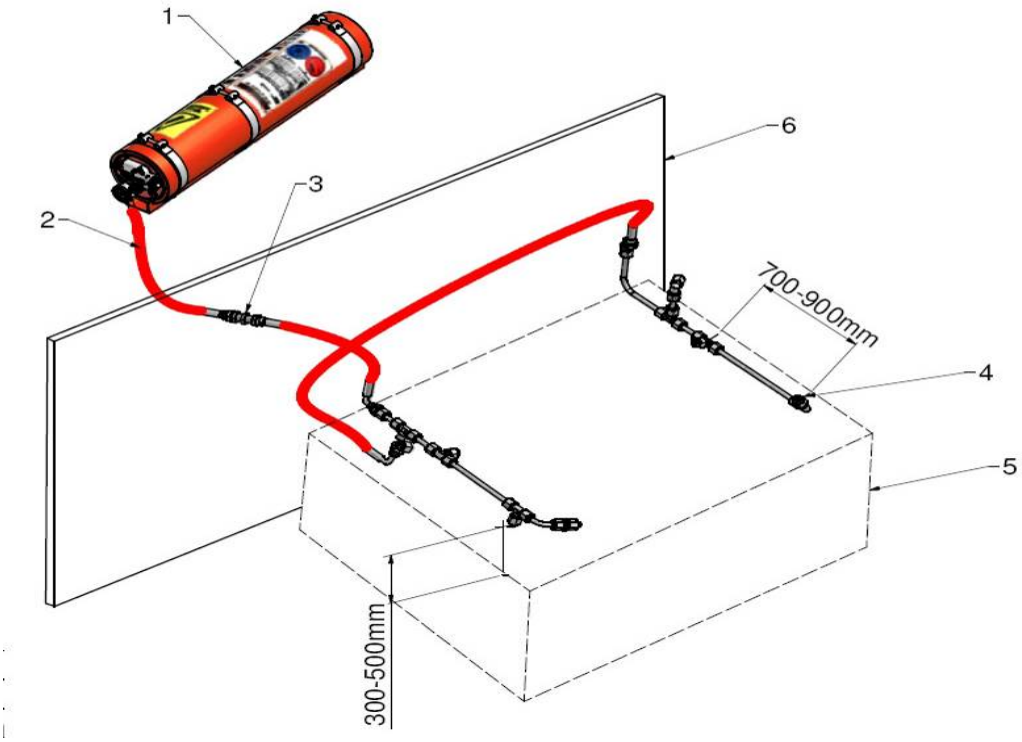


Fig. 13.1 Example of a complete system.
(1) piston accumulator, (2) hydraulic hose, (3) bulkhead lead-through, (4) pipe system with nozzles, (5) engine, (6) partition.

The most common connectors used in the set-up of the pipe system are T-connector part no. FM-4401, straight connector part no. FM-4402 and 90° elbow part no. FM-4409. Only connectors supplied by Fogmaker® may be used. These parts adhere to the standard DIN 2353-EN ISO 8434-1.

1. Cut the tubing at 90 degree angles. Remove all burrs.
2. Use mineral oil to lubricate the cone and thread on the fitting body, the cutting ring, and the thread on the nut.
3. Fit the nut and the cutting ring on the tube as shown in fig. 13.2. The large diameter of the cutting ring must face the nut.
4. Insert the tube into the cone until it comes into contact with the stop on the fitting body. Tighten the nut by hand until the cutting ring rests firmly on the nut. Then tighten the nut with a wrench until the cutting edge of the ring is in contact with the tube and prevents rotation of the tube.
5. Hold the tube against the fitting body, stop and make sure it does not rotate, and then tighten the nut by ¾ of a turn. This way the cutting ring cuts into the outer part of the tube for the necessary depth and raises an edge in front of its cutting edge while the second cutting edge clinches the tube at the same time.
6. Loosen the nut and check that there is a clearly raised edge all around the tube. The edge must cover 80% of the front of the cutting ring. This check is for the safety of all concerned! If the raised edge is not satisfactory, pre-assembly in step 5 must be repeated. The cutting ring can rotate on the tube.
7. Reassemble the nut on the fitting until it contacts the cutting ring, and then tighten for a further ¼ turn more.

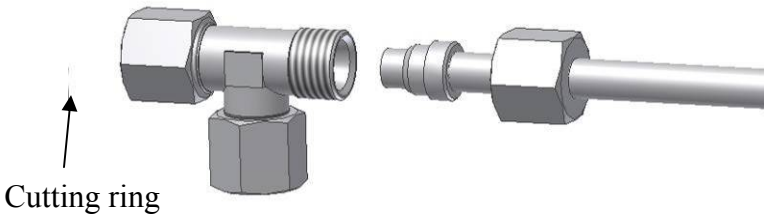


Fig. 13.2 Assembly of pipes on connectors.

Note

It is the responsibility of the installation contractor to ensure that the pipe system is tight and that all connections are tightened according to instructions.

If a hydraulic hose will be used between the piston accumulator and the pipe system, see Section 14. If there is a partition between the space where the piston accumulator is installed and the engine bay, use a bulkhead fitting, part no. FM-4405. Then connect the pipe system in the protected area to the bulkhead grommet with the hydraulic hose (see fig. 13.1). Alternatively, the pipe system can be connected directly to the bulkhead grommet with the connector part no. FM-4405.

Clamp the pipe system in the vehicle every 300 mm with steel-rubber clamps, part no. FM-5308, so that vibrations and sagging are prevented (see fig. 7.3). The maximum distance from an end nozzle to a brace is 100 mm.

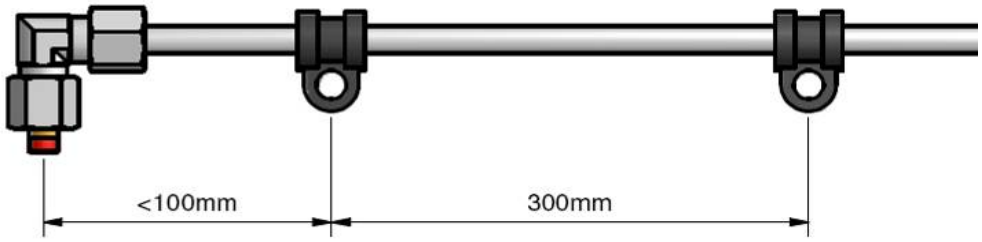


Fig. 13.3 Clamping of the pipe system

Connectors should be suitably clamped with steel-rubber clamps, part no. FM-5318 (see fig. 13.4). It is recommended that T-connectors are clamped on both sides to avoid rotation of unit.

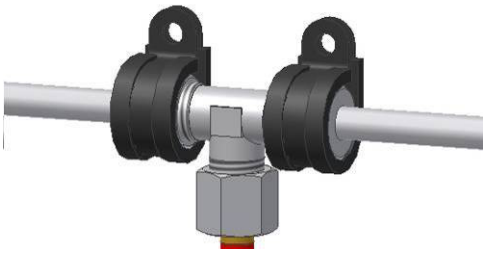


Fig. 7.4 Clamping of a T-connector.

Section 14 Installation of Hydraulic Hose

When installing the hydraulic hose on the piston accumulator, first remove the protection plug on the outlet hole on the valve (see fig. 14.1). Install steel-rubber washer part no. FM-5006 and nipple part no. FM-4307 in the outlet hole and then the valve hose.

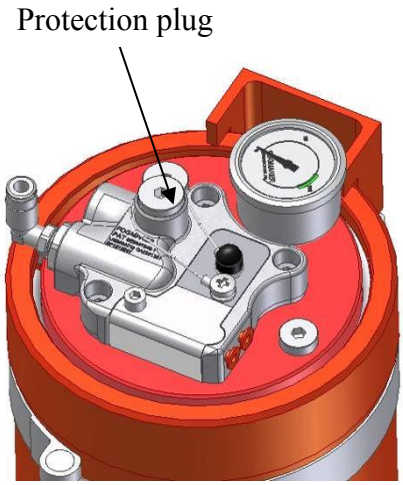


Fig.14.1 Removal of protection plug.

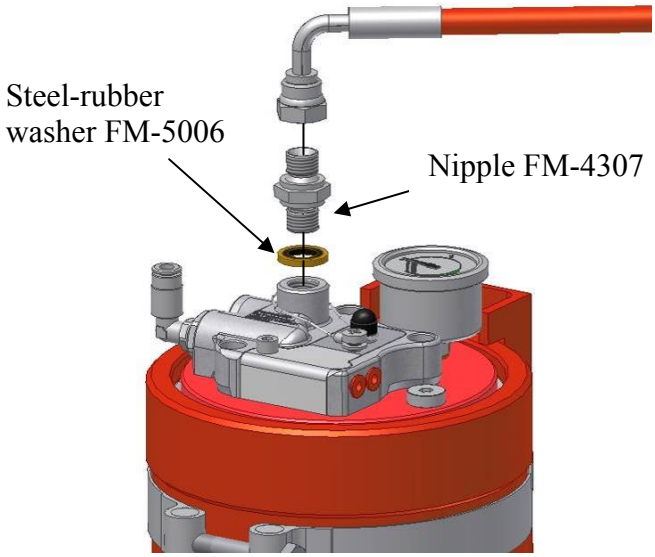


Fig.14.2 Installation of hydraulic hose.

Then mount the hydraulic hose on the bulkhead fitting or on the pipe system with the end-connector or T-connector.

Fix the hydraulic hose every 300 mm with steel-rubber braces, part no. FM-5314, or with wire ties with a width of at least 7 mm.

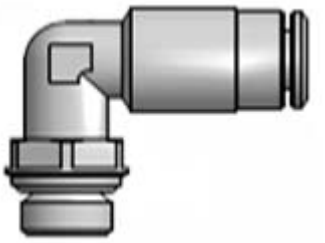
Section 15 Unit Limitations for UL-Listed Components

The following unit limitations apply only to Fogmaker® units containing UL-listed components. For a complete listing of UL-approved Fogmaker® parts, see the Fogmaker® Parts Catalog.

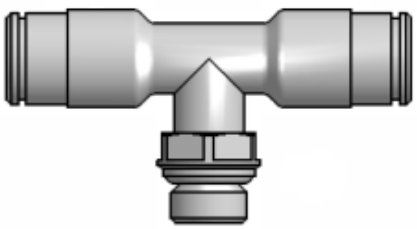
15.1 Detection Tubing

The detection tubing may have a total length of no more than 11.5 m.

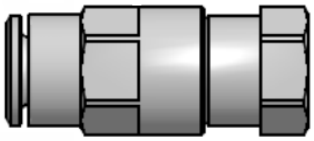
The detection tubing should be installed with no more than one each of the following fittings:



Detection tube fitting SR L6-1/8
Part no. FM-4254



Detection tube T-fitting T6-1/8-6
Part no. FM-4253



Detection tube end plug
Part no. FM-4258

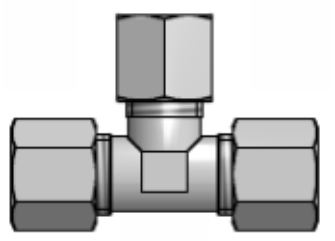
Do not splice detector tubing under any circumstances.

15.2 Pipe System

For UL listed units, the following maximum piping and fitting limitations apply to the overall distribution system. Installation and fabrication techniques are the same as described in Sections 13 (tubing) and 14 (hose).

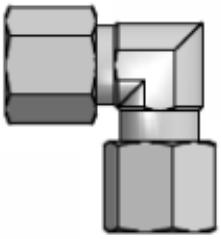
The stainless steel distribution piping may have a total length of no more than 14 m, which includes any hydraulic hose the unit may contain. Hydraulic hose may not exceed 1.5 m or 5 ft in length. The total length of tubing and hose may not exceed 17.5 m.

The distribution piping may have no more than 24 fittings. These can include no more than 13 T-fittings, 2 straight fittings, or 20 90° elbow fittings for a total number of fittings not to exceed 24. The distribution piping is to have no more than 20 90° bends at the minimum bend radius of 24 mm.



Equal T-fitting 8x8x8
Part no. FM-4401

Straight fitting 8x8
Part no. FM-4402



Equal 90 degree elbow 8x8
Part no. FM-4409

15.3 Nozzles

A Fogmaker® unit with a 4.0 L piston accumulator may use at least 3 and no more than 6 nozzles, depending on the liter flow per minute of the nozzles. A unit with a 7.5 L piston accumulator may use at least 6 and no more than 14 nozzles, depending on liter flow per minute.

The maximum length between the piston accumulator and the first nozzle is 8 m. No more than 5 ft (1.524 m) of that 8 m length may consist of hydraulic hose.

The maximum length between the first nozzle and the last nozzle is 6 m.

For more details on nozzle placement and limitations in UL-listed units, see Section 12.

Section 16 Arm/Disarm Instructions

WARNING

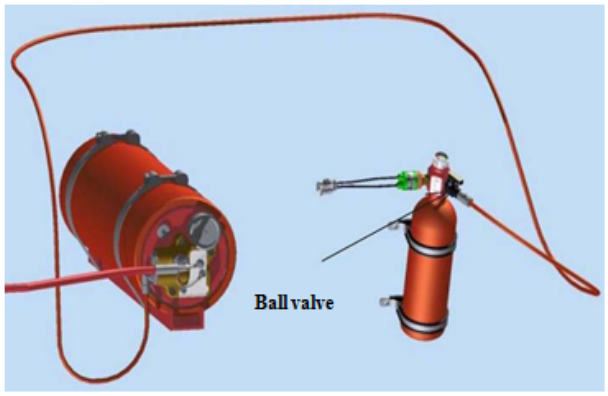
Do not perform the steps in this section until the Fogmaker® fire suppression unit is 100% installed and inspected. The following steps will arm the unit.

16.1 Standard Valve

Note: Make sure all fittings and clamps are tight and the end plug is installed on the detection tube before pressurizing.

Pressurizing of the detection tube

For detection tube less than 14 meters:



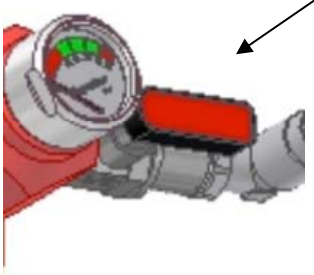
Pressurize the detection tube by slowly opening the ball valve on the detection bottle.

The detection fluid will fill the detection tube.

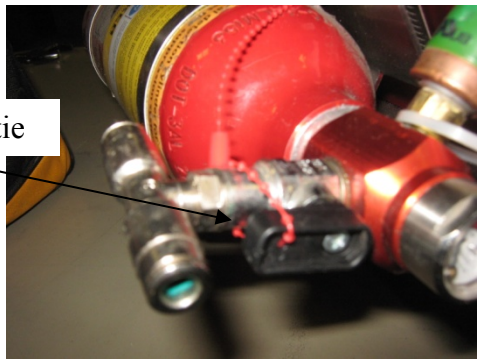
The fluid is colored to make it visible in the tube. There will be an air bubble in the end of the tube ca. 1 m. long. This air bubble will disappear slowly over several weeks. Pressure will drop about 0.5 bar.

Final pressure in the fire detection system should be between 20 and 24 bar on the gauge.

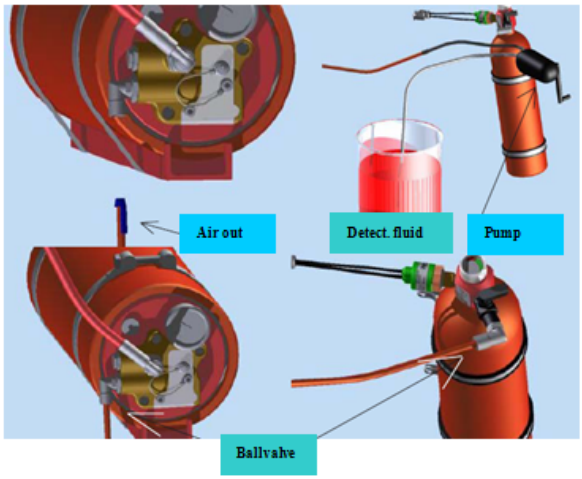
Ball valve open (pressurized)



Ball valve locked open with wire tie



For detector tubing longer than 14 meters:



- Fill the detection tube with accompanying detection fluid, using the Fogmaker® detection fluid pump.
- Fill first the pump with fluid by submersing both suction and pressure hose into detection fluid during rotating the pump handle.
- Then attach the pressure hose of the pump to the detection tube.
- Fill the detection tube until detection fluid comes out the other end to ensure that all air is gone.
- Install tube end into the piston accumulator or end plug.
- Pressurize the detection tube. **Slowly** open the ball valve mounted on the detection cylinder.
- Final pressure in the fire detection system should be between 20 and 24 bar.

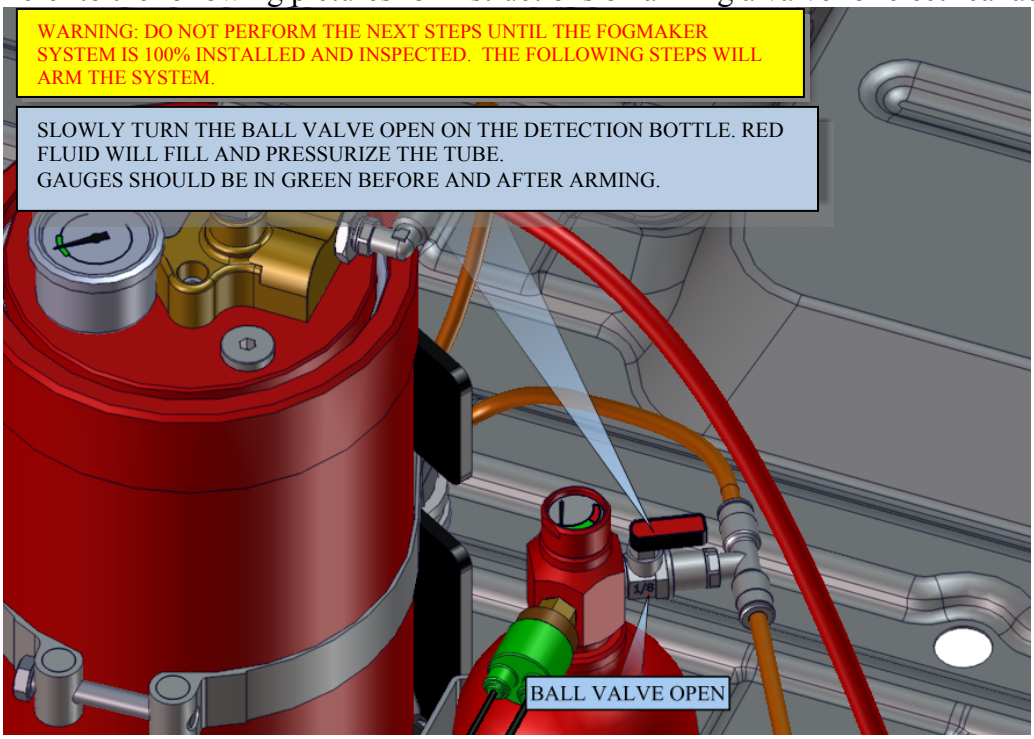
Arm the extinguisher by removing the safety screw as shown (yellow label).

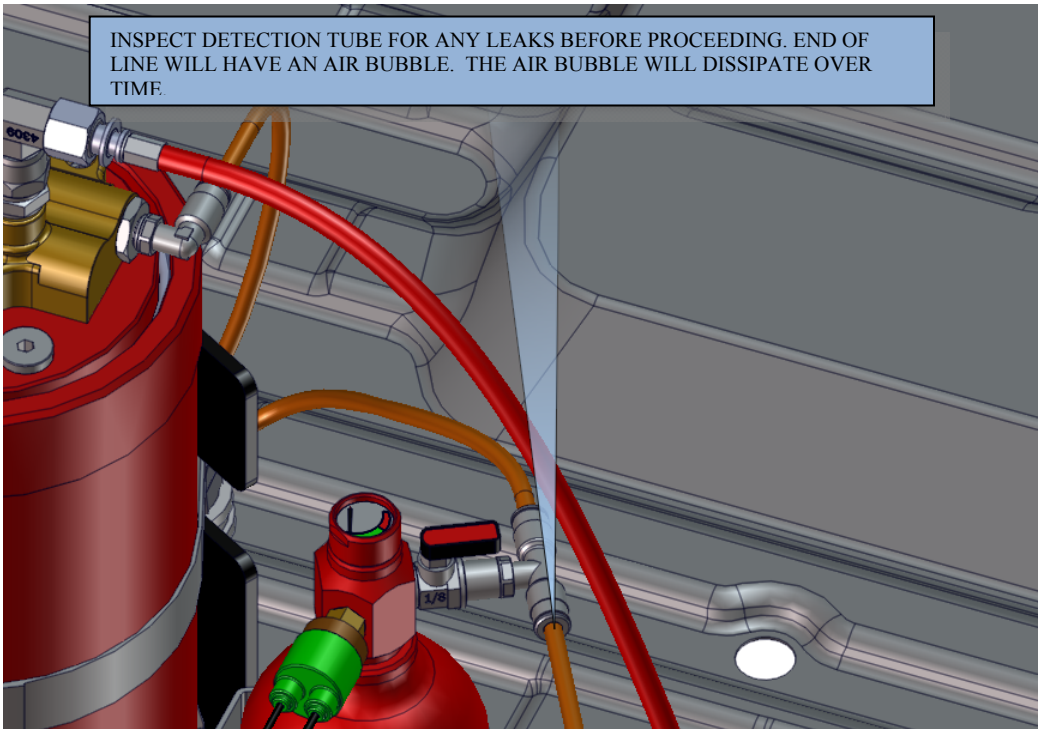
The safety screw should always be attached to the wire to avoid loss.

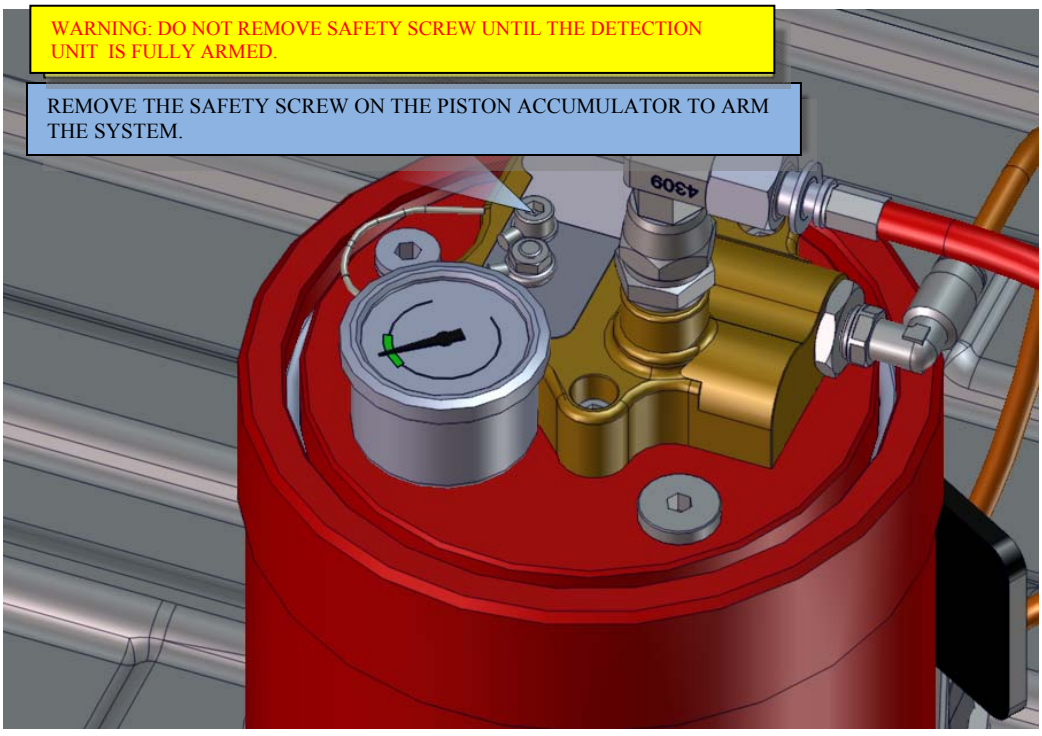
To disarm the system, simply insert the safety screw and close the ball valve on the detector bottle.

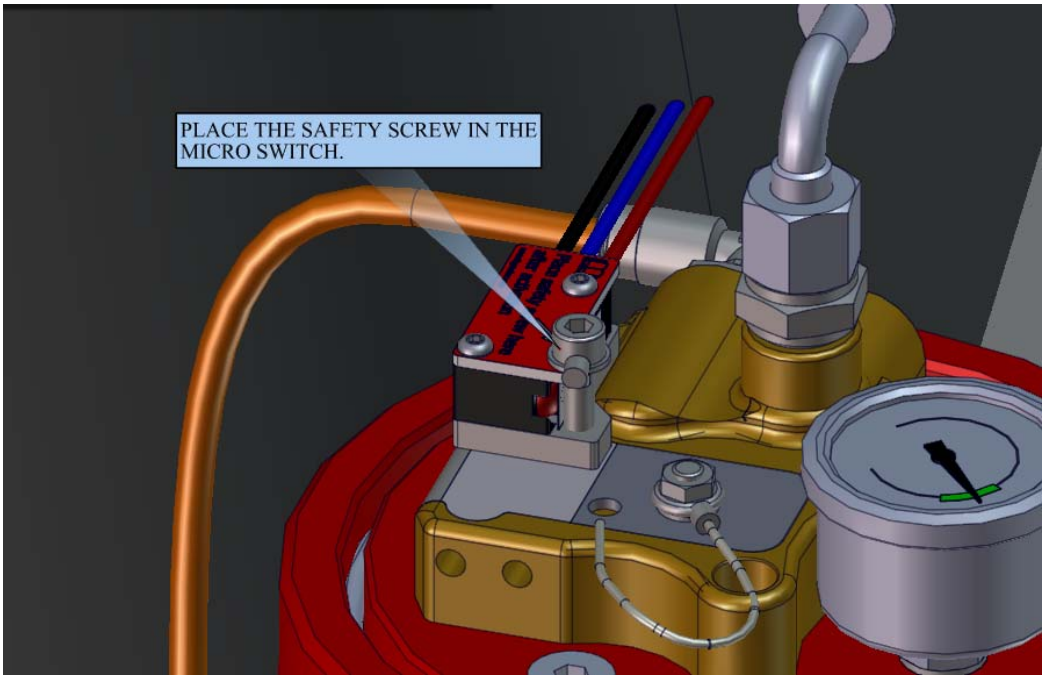
16.2 Valve for Electrical Activation*

Refer to the following pictures for instructions on arming a valve for electrical activation.




INSPECT DETECTION TUBE FOR ANY LEAKS BEFORE PROCEEDING. END OF LINE WILL HAVE AN AIR BUBBLE. THE AIR BUBBLE WILL DISSIPATE OVER TIME.
4309
1/8


WARNING: DO NOT REMOVE SAFETY SCREW UNTIL THE DETECTION UNIT IS FULLY ARMED.
REMOVE THE SAFETY SCREW ON THE PISTON ACCUMULATOR TO ARM THE SYSTEM.
4309



To disarm the system, simply insert the safety screw and close the ball valve on the detection bottle.

Section 17 Functional Check After Installation

1. The Fogmaker® piston accumulator is tested for leakage for at least 3 days after production prior to delivery, so testing by the customer is not necessary.

2. A test of the tightness of the pipe system must be carried out by connecting compressed air to one end of the piston accumulator connection, after which all connections and joints are sprayed with leakage spray and are observed. (Nozzles are to be temporarily replaced with plugs during this test.) Make sure that all nuts for the pipe and nozzle connectors have been tightened in correctly. Mark all nuts after check with paint marker. Draw a line over every nut and connector body. This will indicate and remind that each nut has been checked.

3. A hydro pneumatic detection system is checked after the ball valve on the detection container has been opened, after which all the joints and connections are tested for leakage with leakage spray. Any possible leaks are rectified. The gauge on the hydro pneumatic system should thereafter be observed for a minimum of one week. The pressure shall be between 20-24 bar.

4. For electrical systems*, check that all wires are correct and that there are no faulty connections. Check the alarm panel function per the appropriate Alarm Panel Manual.

5. This fire suppression unit is to be maintained and inspected according to the Standard for Extinguishing Agent Extinguishing Systems, NFPA 17.

Section 18 Action In Case of Fire

The following shall be observed in the event of fire in the protected area:

1. Stop engines, cooling and HVAC System.

2. Turn off the main power switch.

3. If possible, close doors/lids to the protected area.

4. Activate Fogmaker®. If the system is not fully automatic or is in the manual position, pull the wire handle or press the release button.

5. Close the fuel supply to the engine.

6. If possible, keep doors/lids to the protected area closed for five minutes after suppressing. Have a hand fire extinguisher on standby if the fire should flame up again.

Section 19 Actions After Suppressing

The suppression fluid contains frost protection, rust inhibitor, and film-forming liquids that are broken down by natural organisms. When the fluid dries, the corrosion protection loses its effect. In order to avoid corrosion on metal parts, these parts must be cleaned as soon as possible. This is done by flushing with fresh water, preferably under high pressure. Also use some form of alkaline washing detergent that facilitates the removal of film formation. Otherwise a coating can remain which collects impurities.

The nozzles should be removed and the tube set flushed with fresh water. After flushing with fresh water, the tube set should be blown dry with compressed air.

Refer to system function reset instructions in section 22.

IMPORTANT

In order to protect engines, electrical installations, and other metal parts against corrosion, flush the remains of dried or moist suppression fluid as soon as possible after the release of the piston accumulator (use a high pressure washer if possible), irrespective of whether the piston accumulator has been released in connection with a fire or for other reasons.

Section 20 Control Plan for the Suppression System

The Fogmaker® system should be inspected per the instructions listed in the Service Manual, number 8011-002.

Section 21 Effect of Suppressing

Fogmaker® does not normally harm the function of an engine. If the suppression fluid is sucked into the air intake on the engine, it will not significantly change the function of the engine. However, starting difficulties can occur with diesel engines since the incoming suppression fluid contains water. Note that the suppression fluid can cause corrosion damage if the engine is not cleaned within a short time after the fire. For safety's sake, the engine should be protected by filling it with a little oil and turning over the start motor for a few revolutions. The function of the electrical system can be affected by the suppression fluid and give undesirable short-circuits if the cleaning protocol described in Section 18 is not performed quickly. The protected equipment can be used again once it has been cleaned and the cause of the fire has been eliminated, assuming that the fire itself has not caused damage that must first be repaired.

Section 22 Function Reset after a Fire

After Fogmaker® has been released, the piston accumulator must be refilled. For a hydro pneumatic system, the detection cylinder must be replaced. This must be carried out by authorized personnel. For parts, see the Fogmaker® Parts Catalog.

Take the following actions if the piston accumulator is to be removed and delivered to an authorized repair facility:

1. Install the safety screw in the release valve. See Section 8 for instructions.

2. Remove the hydraulic hose from the release valve on the piston accumulator and inspect and replace when indications of mechanical damage or corrosion are observed.

3. Loosen the wire from the release valve on the piston accumulator for a mechanical system or the electric wire on an electric system*. Remove and replace the detection tube on a hydro pneumatic system.

4. Remove the piston accumulator and the detection cylinder and return them to an authorized service facility for inspection and refilling.

5. Remove the nozzles and flush the pipe system with water. (Rinsing tools can be ordered from Fogmaker®.) Then blow out the pipe lines with 90-100 psi of compressed air.

6. Install new nozzles.

7. When the piston accumulator and the detection cylinder have been refilled, they are to be installed again as in a new installation.

8. Activate the system per the Arm-Disarm Instructions in Section 16.

Section 23 Winter Storage

The suppression fluid in Fogmaker® is, as standard, frost protected to withstand temperatures down to approximately -30°C (-22°F) unless otherwise ordered. If Fogmaker® Universal is installed in places where the temperature during the winter can be lower than the frost protection limit, the piston accumulator must be removed. Refer to Arm-Disarm Instructions in Section 16 before removal.

Section 24 Technical Data

Single Piston Accumulator

Product name	Universal 3.3 l	Universal 4 l	Universal 6.5 l	Universal 7.5 l
Filled Piston Accumulator weight (lb)	23	26	38	42
Volume suppressant fluid approx.	3	3.5	6.3	7

Double Piston Accumulators

Product name	Universal 6 l	Universal 8 l	Universal 13 l	Universal 14 l
Filled Piston Accumulator weight (lb)	46	52	76	84
Volume suppressant fluid approx.	6	7	12.6	14

Triple Piston Accumulators

Product name	Universal 12 l	Universal 11 l	Universal 19 l	Universal 21 l
Filled Piston Accumulator weight (lb)	46	78	114	126
Volume suppressant fluid approx.	12	10.5	18.9	21

Common technical data:

Material

Container	Extruded high resistant aluminum AA 6061 – T6
Mounting brackets	Aluminum, straps of stainless steel
Valve	Brass, pertaining components of stainless steel
Anodizing	Min 20 µm, all aluminum parts

Other specifications

Ambient temperature container	Min. -30°C (-22°F) Max. 65° (149°F)
Suppressant fluid	Water, frost protection, film-former
Frost protection temperature	Standard to -30°C (if not other ordered)
Propellant	Nitrogen
Test pressure cylinder	190 bars
Charging pressure	(approx.) 65 bars at 22°C

Section 25 Material Safety Data Sheets (MSDS)

17.1 Extinguishant -35 Safety Data Sheet Version: 7 Version Date: 12/02/2011

1. Identification of the substance/preparation and of the company/undertaking

Trade name: **Extinguishant -35**

Supplier:

Fogmaker International AB
Box 8005
Sandvägen 4
350 08 Växjö
Tel: +46 (0)470- 77 22 00, Fax: +46 (0)470- 77 22 10
E-mail: info@FMNA.com Internet: www.FMNA.com
VAT no.: 556491-9401

Tel. with emergency situation: +46(0)20- 99 60 00 (Kemiindustrins ERC)

2. Hazards identification

The product is not restricted by any hazards identification.

3. Composition/information on ingredients

Chemical Characterization: High pressure water mist fire extinguishing liquid based water.
Amount is based at freezing point – 35°C

Component	Amount %	CAS	*Einecs nr*	Symbol	R- phrase
Brine of carboxylic acids	25-45	127-08-2 590-29-4	2-4822-2 2096779		
AFFF				Xi	R36/38
1,2-Ethandiol	< 0,5	107-21-1	203-473-3	Xn	R22
Synthetic Surfactant	< 0,2	Trade Secret		Xi	R38-41

Fluorosurfactant Composition	< 0,7	Trade Secret		Xi	R36-52/53
Corrosion inhibitors	< 1,5				
Aliphatic acid, Sodium salt	< 0,5			Xn	R63
Tolytriazol	< 0,1	29385-43-1	249-596-6	Xn	R22
Water	55-75				

4. First-aid measures

Eye Contact: Wash eye thoroughly with water. If irritation persists, obtain medical advice.

Skin Contact: Wash with water and soap.

Inhalation: In case of excessive exposure, get fresh air.

Ingestion: Drink much water, seek medical attention.

5. Fire Fighting Measures

Not flammable, non-burning liquid. Possesses extinguishing properties.

6. Accidental Release Measures

Steps to be Taken if Material is Released or Spilled: Flush with much water, accidental release can be flushed in sink with excess hygiene.

7. Handling and Storage

General Handling: Sink and water should be available close to working place.

8. Exposure Controls / Personal Protection

Personal Protection Normal ventilation, wear plastic gloves. Protect eyes with goggles when contact may occur

9. Physical and Chemical Properties

Physical State	Colorless liquid
Density (kg/m3):	1086-1240
Boiling point (°C):	Ca 109
Melting point (°C):	- 35

PH	Ca 8-9
Solubility (% of the weight):	Unlimited in water, glycol, alcohol and glycerine.
Flash point (°C):	Not flammable

10. Stability and Reactivity

Stability:	Stable at normal conditions, does not react with other water-based heat transfer fluids.
Condition to avoid:	Not suitable materials galvanized steel, zinc and soft solder.

11. Toxicological Information

Skin contact:	A prolonged contact with the skin may give redness or skin chaps.
Eye contact:	Unlikely to cause other than temporary redness on accidental contact.
Ingestion:	The product has a bitter taste, which gives a warning if the product is digested by mistake.
LD50 oral rat:	The product is not toxic. LD50, oral rat: > 5 000 mg/kg.

12. Ecological Information

Persistence/Degradability:	The product is not regarded as being toxic to the environment. components are easily biodegradable, DOC (OECD 301A): 99 days.
Bio-accumulation:	Not bioaccumulating. Most of the components act as fertilizers and enter in to the biological circulation and do not accumulate in any micro organisms, plants or other living species.
Ecotoxicity:	LC50 96h, OECD TG203 (Rainbow Trout, Oncorhynchus mykiss) 13900 mg/l and is not classified as acute aquatic toxic.

Corrosion inhibitors

Biodegradation:	92 % after 18 days. Readily biodegradable.
Aquatic toxicity:	The product is not regarded as being toxic to the environment.
Bio-accumulation:	The product is regarded to have low potential for bio-accumulation.

Fire extinguishing foam

Information on elimination	The product is very well bio-degradable. Approximately 96%

	in 28 days (DIN EN ISO 9888).
COD:	appr. 470.000 mg O2/liter (concentrate; DIN EN 38409-H41-1) appr. 14.100 mg O2/liter (3% solution; DIN EN 38409-H41-1)
BOD5:	appr. 204.000 mg O2/liter (concentrate; DIN EN 1899-1) appr. 6.120 mg O2/liter (3% solution; DIN EN 1899-1)
Influence on sewage systems	Influence unlikely if induced at concentrations lower than the following(TTC Test, DIN 38412 – L3):Concentrate: < 3.800 mg/l(> 265 times diluted)Solution 3%: < 127.000 mg/l(> 8 times diluted)
Fish Toxicity LC50:	appr. 7.500 mg/liter (96h, OECD 203)
Algae Toxicity ErC50:	appr. 95 mg/liter (72 h, OECD 201)
Daphnia Toxicity	EC50:appr. 3.720 mg/liter (48h, OECD 202)

13. Disposal Considerations

Product disposal:	Dispose in accordance with local regulations

14. Transport Information

Not regulated. ADR/RID, IMDG or DGR.

15. Regulatory Information

The product does not fall under any EC labeling regulation.
The safety data sheet is prepared according EC-directive.

16. Other Information

Revision

Fogmaker International AB urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. The product is solely designed for use as extinguishant in Fogmaker® fire suppression system. For all other usage the buyers/users must determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is correct, please contact us for the most recent version.

17.2 Fogmaker Detector Fluid Safety Data Sheet Revision A Version Date: 2/29/2012

12. Identification of the substance/preparation and of the company/undertaking

Trade name: **Fogmaker Detection fluid**

Supplier:

Fogmaker International NA
150 Gordon Drive
Exton PA, 19341
Tel: 610-265-3610 Fax: 610-994-5470
E-mail: info@FMNA.com Internet: www.FMNA.com

Tel. with emergency situation: 610-265-3610

13. Hazards identification

Red liquid. Avoid temperatures above 450F, 232C.

14. Composition/information on ingredients

Chemical Characterization: High pressure water mist fire suppression Loss Of Pressure Detector fluid.
Amount is based at freezing point – 35°C

Component	Amount %	CAS	*Product code*	MSD
Dowfrost See below for Dowfrost (MSDS)	50-55	Mixture	04632	002239
Water	45-50			

15. First-aid measures

Eye Contact: Flush eyes thoroughly with water. If irritation persists, obtain medical advice.

Skin Contact: Wash in flowing water or shower.

Inhalation: Remove to fresh air if effects occur. Consult a physician

Ingestion: No adverse effects anticipated by this route of exposure incidental to proper industrial handling.

Material Safety Data Sheet
Dowfrost :

Section 1: Chemical Product and Company Identification
Product Name: Dowfrost
Catalog Codes: SLD2902
CAS#: Mixture.
RTECS: Not applicable.
TSCA: TSCA 8(b) inventory: Propylene glycol; Potassium phosphate dibasic; Water
CI#: Not applicable.
Synonym: Dowfrost;
Chemical Name: Dowfrost
Chemical Formula: Not applicable.
Contact Information:
Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396
US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**
Order Online: ScienceLab.com
CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300
International CHEMTREC, call: 1-703-527-3887
For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients
Composition:

Name CAS # % by Weight
Propylene glycol 57-55-6 95
Potassium phosphate dibasic 7758-11-4
Water 7732-18-5 2.5
Toxicological Data on Ingredients: Propylene glycol: ORAL (LD50): Acute: 20000 mg/kg [Rat]. 22000 mg/kg [Mouse].
DERMAL (LD50): Acute: 20800 mg/kg [Rabbit]. Potassium phosphate dibasic LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.
Non-corrosive for skin. Non-irritant for skin.
Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Non-corrosive for skin.
Non-sensitizer for skin. Non-permeator by skin. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.
Skin Contact:
In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
Serious Skin Contact: Not available.
Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Serious Inhalation: Not available.
Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.
Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.
Auto-Ignition Temperature: The lowest known value is 410°C (770°F) (Propylene glycol).
Flash Points: OPEN CUP: 102°C (215.6°F).
Flammable Limits: LOWER: 2.6% UPPER: 12.5%
Products of Combustion: These products are carbon oxides (CO, CO2). Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Flammable in presence of oxidizing materials. Slightly flammable to flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks, of reducing materials, of combustible materials, of organic materials, of metals, of acids, of alkalis, of moisture.
Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.
Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.
Special Remarks on Fire Hazards: When heated to decomposition it emits acrid smoke and irritating fumes. (Propylene glycol)
Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.
Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Neutralize the residue with a dilute solution of acetic acid. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.
Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 121°C (249.8°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves (impervious).
Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.
Odor: Odorless.
Taste: Not available.
Molecular Weight: Not applicable.
Color: Colorless.
pH (1% soln/water): Basic.
Boiling Point: 188°C (370.4°F)
Melting Point: May start to solidify at -59°C (-74.2°F) based on data for: Propylene glycol.
Critical Temperature: Not available.
Specific Gravity: 1.05 (Water = 1)
Vapor Pressure: 0 kPa (@ 20°C)
Vapor Density: 2.62 (Air = 1)
Volatility: Not available.
Odor Threshold: Not available.
Water/Oil Dist. Coeff.: Not available.
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, methanol.
Solubility: Easily soluble in cold water, hot water, methanol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Not available.
Incompatibility with various substances:
Reactive with oxidizing agents. Slightly reactive to reactive with acids.
Corrosivity: Non-corrosive in presence of glass.
Special Remarks on Reactivity: Hygroscopic; keep container tightly closed. Incompatible with chloroformates. (Propylene glycol)
Special Remarks on Corrosivity: Not available.
Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.
Toxicity to Animals:
Acute oral toxicity (LD50): 20000 mg/kg [Rat]. (Propylene glycol). Acute dermal toxicity (LD50): 10000 mg/kg [Rabbit].
Chronic Effects on Humans: Not available.
Other Toxic Effects on Humans:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (permeator), of ingestion. Non-irritant for skin.
Special Remarks on Toxicity to Animals: Not available.
Special Remarks on Chronic Effects on Humans: Can cause gastrointestinal disturbances. (Propylene glycol)
Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.
BOD5 and COD: Not available.
Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.
Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations
Waste Disposal:

Section 14: Transport Information
DOT Classification: Not a DOT controlled material (United States).
Identification: Not applicable.
Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information
Federal and State Regulations:
Pennsylvania RTK: Propylene glycol TSCA 8(b) inventory: Propylene glycol; Potassium phosphate dibasic; Water
Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
Other Classifications:
WHMIS (Canada): CLASS D-2B: Material causing other toxic effects (TOXIC).
DSCL (EEC): R36/38- Irritating to eyes and skin.
HMIS (U.S.A.):
Health Hazard: 1
Fire Hazard: 0
Reactivity: 0
Personal Protection: g
National Fire Protection Association (U.S.A.):
Health: 0
Flammability: 1
Reactivity: 0
Specific hazard:
Protective Equipment:
Gloves (impervious). Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information
References: This is a Trademark product of the Dow Chemical Company
Other Special Considerations: Not available.
Created: 10/10/2005 01:04 AM
Last Updated: 11/01/2010 12:00 PM
The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assumeno liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even

if ScienceLab.com has been advised of the possibility of such damages.

Note:

Fogmaker NA urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. The product is solely designed for use as detector fluid in Fogmaker® fire suppression system. For all other usage the buyers/users must determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is correct, please contact us for the most recent version.

Section 26 Performed Functional Tests and Technical Approvals

Testing authority	Standard	Date
ÅF-Kontroll AB Pressure vessel approval	PED 97/23/EC (-40/+65°C)	22-04-2002
Swedac Design Reviev Certificate	AFS 1994:39, LA-91	02-12-1997
The International Automobilist Federation (FIA) Techno. List No 16 (Groups N, A, B)	Art. 253, Safety equipment Homologating no. Ex.001.97,	02-12-1996
The Swedish Testing and Research Institute (SP)	SBF 128 for Busses F325912	11-12-2004
The Swedish Administration of Shipping and Navigation regulations Extinguishing test in 5 m^3	Rep: no. 96 R30737b from 1996-01-11	18-06-1996
The Swedish Administration of Shipping and Navigation regulations for engine bays $\leq$ 5 m^3 for pleasure boats	Type approval File:010203-9770000	04-02-1997

Brandskyddsföreningen The Swedish Fire Protection Association Approved extinguishing test in loaders for the peat industry	SBF 127 Dnr. NF-04-01 04:127 S01	18-05-1998 23-02-2004
Brandskyddsföreningen Certificate for full scale test SBF for homologation of needed water quantity. Approved extinguishing test at 2,0 lit/m3	SBF 127	15-09-2001 15-01-2001
Brandskyddsföreningen The Swedish Fire Protection Association. Approved for extinguishing in buses	SBF 128 Dnr. NF-04-02 04:S 02	23-02-2004
RINA of Italy Approval of fixed aerosol fire extinguishing systems in machinery spaces. Cert no.	ISO 9094-1:2003 ISO 9094-2:2002 FPE 287507CS	01-05-2007
Bureau Veritas of France Cert no. MARINE DIVISION Certificate for machinery spaces up to 96 m^3.	20052/A0 BV	26-04-2008
File number :	ACI 2000/054/001Product code : 5561D	

Fogmaker North America Limited Warranty

2013

WARRANTY:
Fogmaker North America LLC (FMNA) warrants to the original buyer that its Automatic Fire Suppression Systems (AFSS) are free from defects in material and workmanship for a period of two (2) year. FMNA also warrants to the original buyer that its Methane Detection Systems are free from defects in material and workmanship for a period of two (2) years with exception of the Methane Sensors which are covered with a one (1) year warranty. Warranty period begins at time of installation

NON-PRORATED REPLACEMENT:
In the event that a warranty-covered failure should occur within the warranty period, FMNA will repair or replace the system without charge and without prorating, at FMNA's option. This is the sole and exclusive remedy for breech of any warranty. Any replacement system or part is only covered by this warranty for the remainder of warranty period applicable to the original system.

EXCLUSIONS:
This warranty specifically excludes any items exposed to normal wear and tear such as metal finish and paint and does not apply to any system that is damaged as result of accident, derailment, improper installation, structural defects, intentional damage, abuse, vandalism, negligence, misuse, improper operating conditions, or extreme natural phenomena. Systems exposed to toxic or corrosive materials are excluded from this warranty. This warranty is provided directly to the purchaser only and does not extend to any subsequent party and is solely for the FMNA product as it is originally manufactured.

INCIDENTAL, CONSEQUENTIAL DAMAGES, & LIMITATIONS:
This warranty shall be in lieu of any other warranty, expressed warranty, expressed or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose. The purchaser's sole and exclusive remedy against FMNA shall be for the repair and replacement of the defective product as provided herein. No other remedy; including but not limited to incidental or consequential damages for lost profits, lost sales, injury to person or property, shipping, freight, installation, removal, or any other incidental or consequential loss shall be available to the purchaser.

NOTIFICATION:
All reports, claims, or notices required by the warranty to be provided to FMNA must be in writing and delivered to: Attention – FMNA Warranty Claim Department, 150 Gordon Drive, Exton, PA 19341. Repairs being claimed for warranty must be sent to

FMNA for prior approval and warranty acceptance before any warranty claims can be made. Parts being claimed for warranty must be sent to FMNA for prior approval and warranty acceptance before any warranty claims can be made.

INSPECTION AND VERIFICATION:
The owner must provide access to the failed system so that FMNA's authorized representative can perform an on-site inspection. Within 30 days of the inspection, FMNA will render an opinion as to whether or not the claimed failure is covered by the warranty. This inspection will be executed utilizing the FMNA Certification Report ensuring the execution matches the original certified installation.

GENERAL MAINTENANCE:
FMNA provides the proper maintenance instructions, as well as recommended service intervals with each system. Warranty is contingent upon documented performance of recommended maintenance and service. All replacement parts should be recommended or authorized FMNA components. Failure to purchase proper components will null and void the warranty.

DESIGN:
FMNA reserves the right to modify parts and design specifications without notice as long as the systems meet general specifications, unless otherwise committed per contract. In case further non-conforming changes have to be incorporated, FMNA will submit such changes to customer for prior approval.

Warranty – FogmakerNA Nov10.doc

FMNA Fire Suppression System
__ Inspection Report __ Installation Report
__ Service Report

Service Technician	Order #
Date	Work Site
Customer	# of Nozzles **
	Piston Accumulator Serial #
Address	PA Gauge Reading
City, State, Zip	Detector Serial #
Contact Name	Detector Gauge Reading
Contact Phone	Vehicle Year/Model
End User	
Vehicle #	
Vehicle Mfg.	

** Contact FMNA Engineering or OEM for correct number & placement of nozzles

1 Piston Accumulator (PA)

		YES	NO	NA
1.1	**Control Fixture/ Vibration Damage**			
	Are all mounting locations of the PA intact with no signs of wear or breakage?			
1.2	**Control Protection Box / Labels**			
	Is the protection box intact with no signs of wear or breakage?			
	Are all labels visible and legible?			
1.3	**Control Leakage / Corrosion**			
	Is there any indication of leakage or corrosion around the PA couplings/valve/connections?			
1.4	**Change of Service Interval Label / Control of Gauge Pressure**			
	Is the service interval date label changed for next inspection?			
	For annual inspections only, is the annual inspection label replaced as required for warranty?			
	Is the pressure gauge indicating in the green area on the PA and pressure reading recorded on this form?			
	Is the safety screw for the release valve located on the PA removed and is the system active?			

2 Cable Activation / Electric Activation*

BEFORE PERFORMING ANY WORK ON ACTIVATION, RE-INSERT THE SAFETY SCREW!

		YES	NO	NA
2.1	**Checking the Cable or Electric Activation***			
	Is the manual or electric punch* properly installed and properly connected?			
	For cable activation, inspect the handle lever for proper sealing and/or damage.			
	Lubricate cables and handle assembly, if applicable.			
	Check cables and harness connections on electrical punch*, if applicable.			
	Confirm the pull pin can be removed on the manual button.			

3 Sprinkler System / Hydraulic Hose (Distribution System)

		YES	NO	NA
3.1	**Control for Vibration Damage / Wear**			
	Are there any indications of damage/wear on any hoses or pipes in the system?			
	Are the stainless pressure lines free of kinks and nicks?			
3.2	**Control for Braces (Clamps), Tightness**			
	Are all braces or clamps secure per the installation instructions and in good condition?			
	Are all connections tightened per the requirements in the installation instructions?			
3.3	**Control for Protective Covers / Proper Positioning of Nozzles**			
	Are the proper number of nozzles installed?			
	Are all nozzles properly positioned per First Article Inspection and free of obstructions?			
	Are the protective covers for the nozzles in position and clean? If not, replace with new ones.			
3.4	**Control for Breakages / Cracks on Hydraulic Hoses**			
	Are all hoses secure and in good condition?			
	Are all hoses & tubing connections tight with no possibility for leaks?			

4	**Detection System**	YES	NO	NA
4.1	**Control for Detection Gas Cylinder / Detection Fluid Cylinder**			
	Are all mounting locations of the detection bottle intact with no signs of wear or damage?			
	Is the pressure gauge indicating in the green area on the detection bottle and the pressure reading recorded on this form?			
4.2	**Control for Detection Tube / Clamps**			
	Is the routing and fixture of the detection tube free from wear or other damage?			
	Is there any area of the detection tubing unprotected?			
	Is the detection tube free of abrasions and secured, and does nothing contact the tube through the protective coil, etc.?			
	Are all tubing connections tight with no possibility for leaks?			
4.3	**Control for Damage to Protective Tube / Protective Coil (Spiral)**			
	Is there any wear, pinching, or other damage to the protective tube or protective coil?			
	Is the protective coil secure and are the ends properly bent according to the Installation Manual?			
4.4	**Control for Labels on the Detection Tube**			
	Are the Red “FIRE DETECTOR” labels clearly visible on the detection tube? Replace as needed.			

5	**Alarm Panel* / Alarm Device* / Cables***	YES	NO	NA
5.1	**Check for Slackness / Breakage / Cracks**			
	Is there any slack in the cables and are all joints/cables undamaged?			
5.2	**Function Test/Fire Simulation**			
	Is the green light illuminated on the control panel and does there appear to be no evidence of tampering?			
	Has the control panel been tested per the instructions on the panel?			

6	**Other**	YES	NO	NA
	Is all electrical wiring intact and showing no sign of wear or damage?			
	Are all control labels up to date and visible?			
	Check if customer would like the system manuals sent electronically and notifiy customer service.			

Additional Comments:

Service Tech (Printed) _____ Customer Name (Printed) _____

Signature _____ Customer Signature _____

Company _____ Date _____

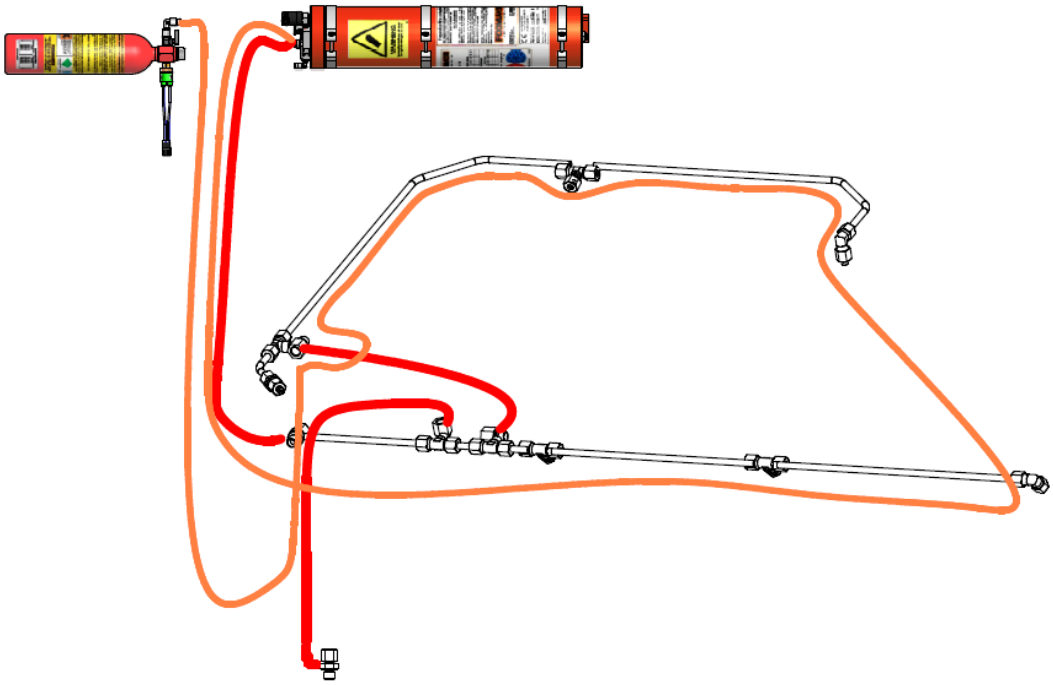
Date _____

Note: It is the customer's responsibility to ensure that all service checks are performed in accordance to Fogmaker North America's guidelines as indicated in the Installation Manual. Services and/or maintenance must be performed by a Fogmaker trained, certified technician.
It is the responsibility of the customer to correct any problems as indicated by this document to ensure the proper function of the system.

Fogmaker®

Service manual

Fire-suppressing with water mist for
Enclosed spaces



Fogmaker North America

Post address:
150 Gordon Dr
Exton, PA 19341

Delivery address:
150 Gordon Dr
Exton, PA 19341

Tel: 610-265-3610
Fax: 610-265-8327

info@fogmaker-na.com
www.fogmaker-na.com

8011-002 Service Manual – Rev B

WARNING

The safety screw shall always be installed during transport, installation and service. When the safety screw and protection plates are removed, Fogmaker® can be released with light pressure on the release catch under the protection plate by mistake. The release valve must not be removed when the container is pressurized. If the valve or any of its nipples or connectors are removed when the container is pressurized, a powerful fluid spray 940 psi (65 bar) can be emitted and cause serious personal injury.

Control plan for the suppression system

The suppression system shall be serviced once a year by authorized personnel according to the control plan below. Every sixth year the piston accumulator (PA) shall be serviced and the suppression fluid shall be changed. The service may only be carried out by authorized personnel.

Control plan for weekly inspection

A visual inspection of the system components should be carried out every week to ensure that the system has not received any damage. Repairs should be completed by authorized personnel.

Control plan for daily inspection

Check that the pressure in the piston accumulator is correct by the gauge being in the green swept area. The pressure in the detector fluid bottle shall be in the green swept area. The pressures do not need to be checked if PA & Detector has electronic monitoring with pressure switches.

Control plan for annual service

1. Piston Accumulator / cylinder

1.1 **Control for mounting / vibration damage to the piston accumulator**

Check all mountings for any damage to the piston accumulator or other components or the suppression peripheral equipment.
Also check that there is no vibration damage.

1.2 **Control for protecting box / labels**

Check the condition of the protecting box so that it protects the piston accumulator satisfactorily and that the mounting is intact.
Check labels and markings so that they are readable and easily visible.
Replace with new ones if required. Check that the date is less than 6 years from manufacture date. Perform 6 year service if required.

1.3 **Control for leakage / corrosion**

Check that there is no leakage / corrosion around the piston accumulator couplings / connections and valves.

1.4 **Change of service interval label / Control of gauge pressure**

Change the service interval label and attach the new one with the correct month towards the arrow. Check the gauge pressure and note it on the inspection report.
Note! The pressure should be in the green swept area. If deviations occur, contact Fogmaker or authorized service provider

2. Cable activation

2.1 Start by screwing in the safety screw in the valve.
Check that all the releases are sealed and that all the wires run easily without damage to the wires or the releases that can affect their function.
Remove the protective cover on the valve and free the wire so that it is possible to test its function.
Spray with lubricating oil CRC 5-56 or the equivalent on the valve mechanism.
Restore the wires and valve as well as sealing the releaser again.

3. Sprinkler system / hydraulic hose (distribution system)

3.1 **Control for vibration damage / wear**

Check that there is no damage/wear on any hoses or pipes in the system.

3.2 **Control for braces (clamps), tightness**

Check that braces for wear and that the pipe system is tightened in the correct way according to the installation manual.
Check that all connections are tightened so that there is no risk for leakage.
If a leakage is suspected, the system must be test pressurized according to the installation manual.

3.3 **Control for Red protective covers for nozzles**

Visually check that the Red protective covers are in position and clean. If not, replace with new ones.

3.4 **Control for breakages / cracks on hydraulic hoses**

Check hydraulic hoses for possible cracks or breakages that can cause faults or leakage when the system is released.

4. Detector system

4.1 **Control for detector gas cylinder / detector fluid cylinder**

Check the condition and the fixture of the cylinder. The gauge pressure shall be in the green segment. If not, contact Fogmaker for consultation.

4.2 Control for detector tube/Clamps

Check the routing and fixture of the detector tube so that no wear or other damage can occur. Check that nothing is rubbing the detector tubing through the protective coil.

4.3 Control for damage to protective tube / protective coil (spiral)

Check that there is no wear, pinching or other damage to the protective tube or protective coil and that it is secure according to the installation manual.
Check clamps for wear and tightness.

4.4 Control for labels on the detector tube

Check that the Red "FIRE DETECTOR" labels (part # FM-8206) are clearly visible on the detector tube so that it cannot be misinterpreted that it is a detector tube. Replace if damaged or missing.

5. Alarm panel / Alarm device / Cables

5.1 Check for slackness, breakage and cracks

Check that is no slackness in the cables and that all joints / cables are undamaged.

5.2 Function test/Fire Simulation

Check that the Green indicator light is on.
Simulate a fire by taking apart the contact to the pressure switch on the detector cylinder or and the piston accumulator.
Refer to the Alarm Panel Manual for function test.

6. Other items

6.1 User manual

Check that there is a user manual in the vehicle.
Add if required. (Missing)

6.2 Activation labels/Control Labels

Check that there are activation/control labels according to the instructions in the installation manual.

6.3 Control if safety screw is out!!!

Check that the detector system is activated and that the safety screw is removed from the PA valve. Refer to the Arm/Disarm Instructions.

FMNA Fire Suppression System
__ Inspection Report __ Installation Report
__ Service Report

FOGMAKER NORTH AMERICA

Service Technician	Order #
Date	Work Site
Customer	# of Nozzles **
Address	Piston Accumulator Serial #
City, State, Zip	PA Gauge Reading
Contact Name	Detector Serial #
Contact Phone	Detector Gauge Reading
End User	Vehicle Year/Model
Vehicle #	
Vehicle Mfg.	

****** Contact FMNA Engineering or OEM for correct number & placement of nozzles

1 Piston Accumulator (P.A.)

		YES	NO	NA
1.1	**Control Fixture/ Vibration Damage**			
	Are all mounting locations of the P.A. intact with no signs of wear or breakage?			
1.2	**Control Protection Box / Labels**			
	Is the protection box intact with no signs of wear or breakage?			
	Are all labels visible and readable?			
1.3	**Control Leakage / corrosion**			
	Is there any indication of leakage or corrosion around the P.A. couplings/valve/connections?			
1.4	**Change of service interval label / Control of gauge pressure**			
	Is the service interval date label changed for next inspection?			
	For annual inspections only, is the annual inspection label replaced as required for warranty?			
	Is the pressure gauge indicating in the green area on the P.A. & pressure recorded on this form?			
	Is the safety screw on the P.A. removed?			

2 Cable activation / Electric Activation

BEFORE PERFORMING ANY WORK ON ACTIVATION, RE-INSERT THE SAFETY SCREW!		YES	NO	NA
2.1	**Checking the cable or electric activation**			
	Is the manual or electric punch properly installed and properly connected?			
	For cable activation, check handle lever for sealing or damage			
	Lubricate wires & handle, if applicable.			
	Check wires and harness connections on electrical punch, if applicable.			
	Can the pull pin be removed on the manual button?			

3 Sprinkler system / hydraulic hose (distribution system)

		YES	NO	NA
3.1	**Control for vibration damage / wear**			
	Is there any damage/wear on any hoses or pipes in the system?			
	Is the Stainless free of kinks and nicks?			
3.2	**Control for braces (clamps), tightness**			
	Are all braces or clamps secure per the installation instructions and in good condition?			
	Are all connections tightened so that there is no risk for leakage?			
3.3	**Control for Red protective covers & Proper positioning of nozzles**			
	Are the proper number of nozzles installed?			
	Are all nozzles properly placed per customer or FMNA drawing and free of obstructions?			
	Are the Red protective covers position and clean? If not, replace with new ones.			
3.4	**Control for breakages / cracks on hydraulic hoses**			
	Are all hoses secure and in good condition?			
	Are all hoses & tubing connections tight with no possibility for leaks?			

		YES	NO	NA
4	**Detector System**			
4.1	**Control for detector gas cylinder / detector fluid cylinder**			
	Are all mounting locations of the detector bottle intact with no signs of wear or breakage?			
	Is the pressure gauge indicating in the green area on the detector bottle & pressure reading recorded on this form?			
4.2	**Control for Detector Tube/Clamps**			
	Is the routing and fixture of the detector tube free from wear or other damage?			
	Is there any area of the detector tubing unprotected?			
	Is the detection tube free of abrasions, secured, & nothing contacting tube through coil, etc.?			
	Are all tubing connections tight with no possibility for leaks?			
4.3	**Control for damage to protective tube / protective coil (spiral)**			
	Is there any wear, pinching, or other damage to the protective tube or protective coil?			
	Is the protective coil secure according and the ends properly bent according to the installation manual?			
4.4	**Control for labels on the detector tube**			
	Are the Red “FIRE DETECTOR” labels are clearly visible on the detector tube? Replace as needed			
5	**Alarm panel / Alarm device / Cables**	YES	NO	NA
5.1	**Check for slackness, breakage and cracks**			
	Is there any slack in the cables and are all joints / cables are undamaged?			
5.2	**Function test/Fire Simulation**			
	Is the green light illuminated on the control panel and no evidence of tampering?			
	Did you test the control panel per instructions on the panel?			
6	**Other**	YES	NO	NA
	Is all wiring intact and shows no sign of wear or melting?			
	Are all control labels up to date and easily shown?			
	Check if customer would like a manual sent electronically and notify customer service			

Additional Comments:

Service Tech (Printed) _____ Customer Name (Printed) _____

Signature _____ Customer Signature _____

Company _____ Date _____

Date _____

Note: It is the customer's responsibility to ensure that all service checks are performed in accordance to Fogmaker North America's guidelines as indicated in the Installation Manual. Services and/or maintenance must be performed by a Fogmaker trained, certified technician.
It is the responsibility of the customer to correct any problems as indicated by this document to ensure the proper function of the system.

MShield –GD2

Methane Fume Detector
Installation and Operation Manual
MADE IN THE USA.

Sold separately or in conjunction with Fogmaker North America's Fire Suppression System
Contact: Fogmaker NA
150 Gordon Dr
Exton, PA 19464
Ph. 1.610.265.3610

READ THIS MANUAL CAREFULLY AND SAVE FOR FUTURE REFERENCE. KEEP THIS MANUAL WITH THE MShield.

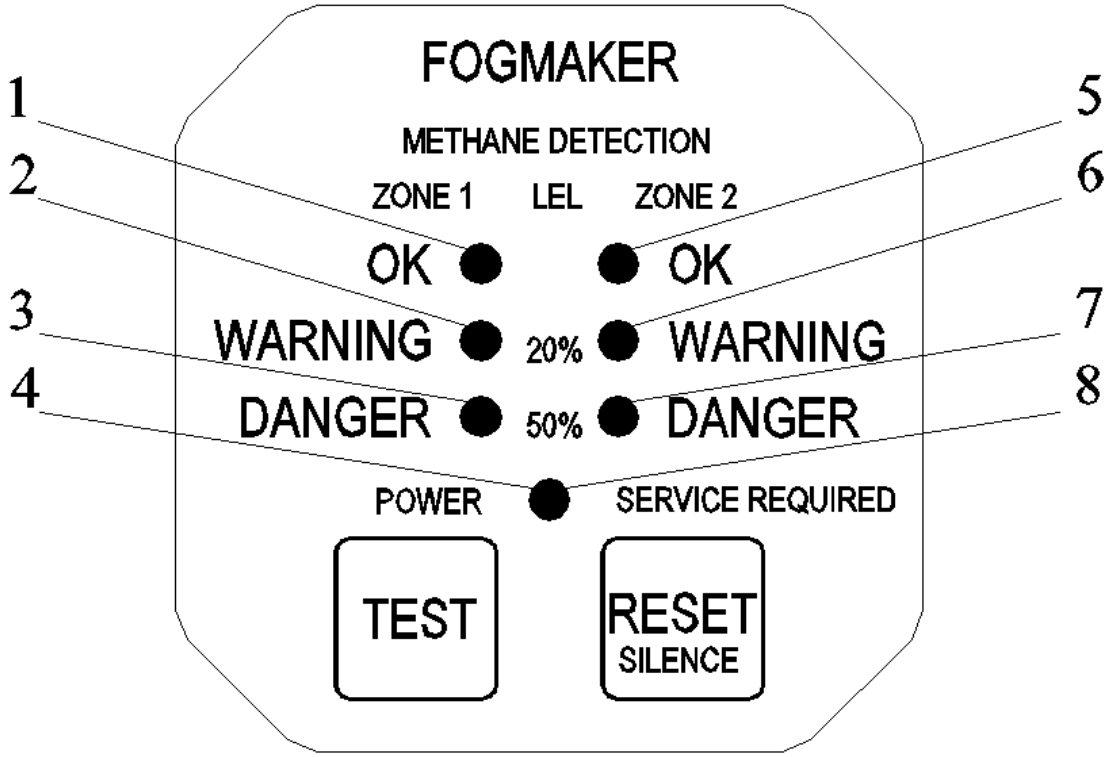
Introduction

The vapor-monitoring system utilizes advanced technology for detection of methane fumes. The MShield allows the connection of four (4) sensors (with optional splitter FM-US-400017) and has both visual and audible alarms that trigger at 20% and 50% LEL of methane respectively. Test switches are provided for full checking of all operations. System operation and correct sensor operation are continually monitored and indicators are provided for fault detection. The MShield

has an internal relay for automatic control of an external device up to 1 amp. Read this owner's manual completely before installation. Failure to read and follow these instructions can result in damage to the unit voiding the warranty.

Components This Kit Includes

- 1 – MSHIELD Display PART NUMBER FM-US-400036
- 2 - MS-3 Sensors part number FM-US-400019
- 1 - S2B CABLE part number FM-US-400047
- 1 – Horn



Optional Components:

MS-3 Cable 5'	Extension Cable for MS-3 Sensor	Part number FMWH-1414-005
MS-3 Cable 10'	Extension Cable for MS-3 Sensor	Part number FMWH-1414-010
MS-3 Cable 15'	Extension Cable for MS-3 Sensor	Part number FMWH-1414-015
MS-3 Cable 20'	Extension Cable for MS-3 Sensor	Part number FMWH-1414-020
MS-3 Cable 25'	Extension Cable for MS-3 Sensor	Part number FMWH-1414-025
Splitter	Splitter for 1 Additional Sensor	Part number FM-US-400017

CAUTION: NO POWER ON/OFF SWITCH IS PROVIDED FOR THIS UNIT. TO FUNCTION AS INTENDED, THE MSHIELDMUST BE CONNECTED TO A CORRECT POWER SOURCE, AND FOR MAXIMUM EFFECTIVENESS, BE POWERED AT ALL TIMES A DANGER MAY BE PRESENT. IF POWER IS ON AND LEFT UNATTENDED FOR AN EXTENDED PERIOD OF TIME, BATTERY POWER MAY BE DIMINISHED.

Manual Display Controls / Indicator

1 – Zone 1 Sensor OK LED	(Green when sensor is detected and sending OK signal)
2 – Zone 1 Sensor Warning LED	(Orange when sensor detects 20% LEL)
3 – Zone 1 Sensor Danger LED	(Red when sensor detects 50% LEL)
4 – Power/Fault	(Green display is functioning properly)
5 – Zone 2 Sensor OK LED	(Green when sensor is detected and sending OK signal)
6 – Zone 2 Sensor Warning LED	(Orange when sensor detects 20% LEL)
7 – Zone 2 Sensor Danger LED	(Red when sensor detects 50% LEL)
8 – Fault	(Yellow system has fault)

Display Installation

The MShield should be mounted in a convenient location, preferably at the source of methane usage where the visual indicators may be readily seen. To install the display, you must first remove the screw on bezel.
Next, drill a 2-1 /16" diameter hole into the panel. Slip the instrument through the hole and secure with the threaded bezel.
For surface mount installation there are 4 locations at the corner's of the display recessed for drilling. By drilling these out with a 3/16" drill bit from the back of the housing. The holes are spaced 2.18" inches from each other in each corner.

Sensor Installation

Install sensor in a location that will be high enough to detect the methane fumes but also out of the path of any kind of constant external air flow or sources of contamination.
Methane is lighter than air and will rise. Therefore, it is important that a location be selected with this in mind.

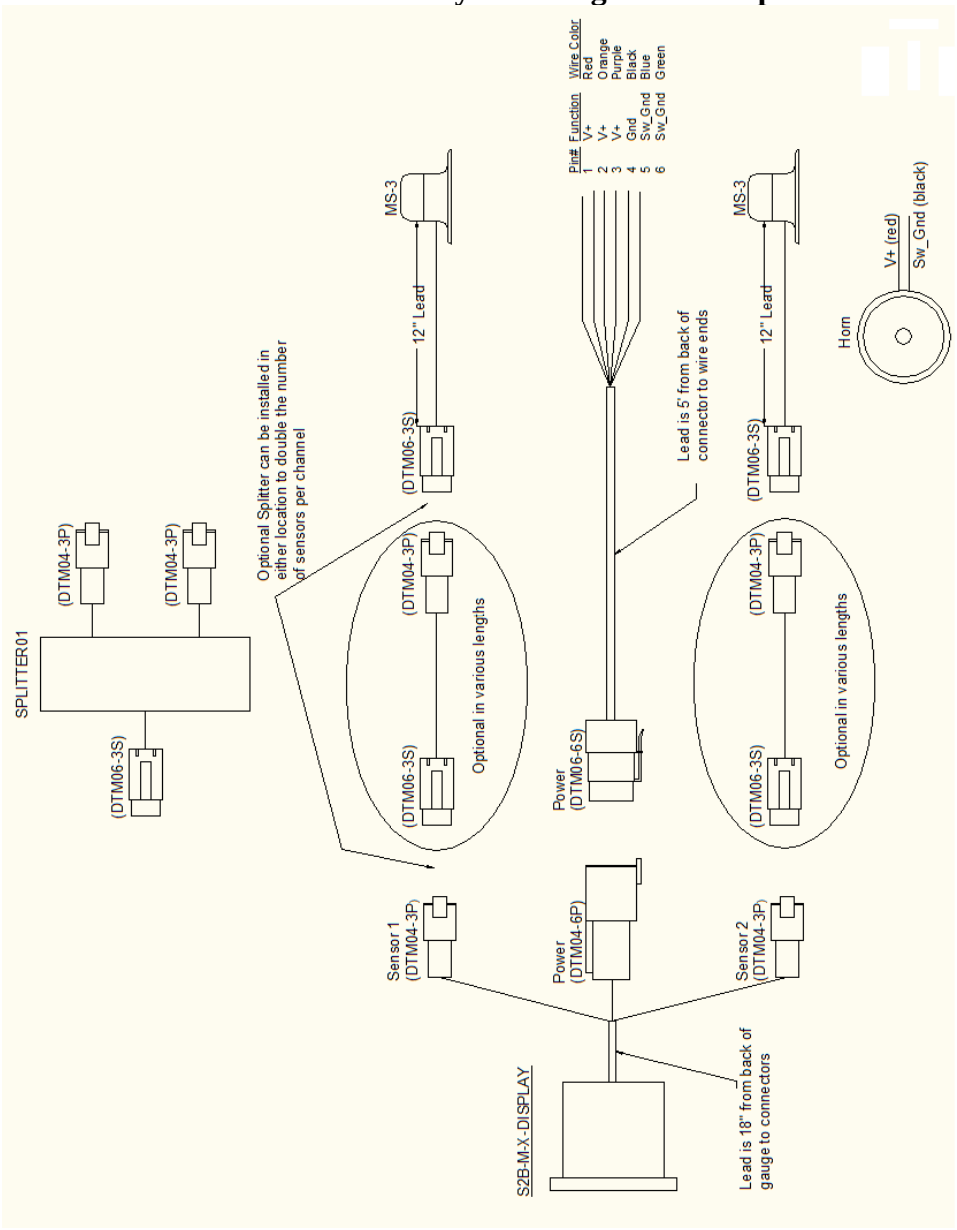
Wiring the MShield

Wire the power connector to the systems 12V battery. Connect the black wire to the Gnd from the battery. Connect the red wire to the positive side of the battery. If auxiliary devices are used that require 12V the orange or purple wire can be used to supply the 12V as they are connected internally to the red wire.

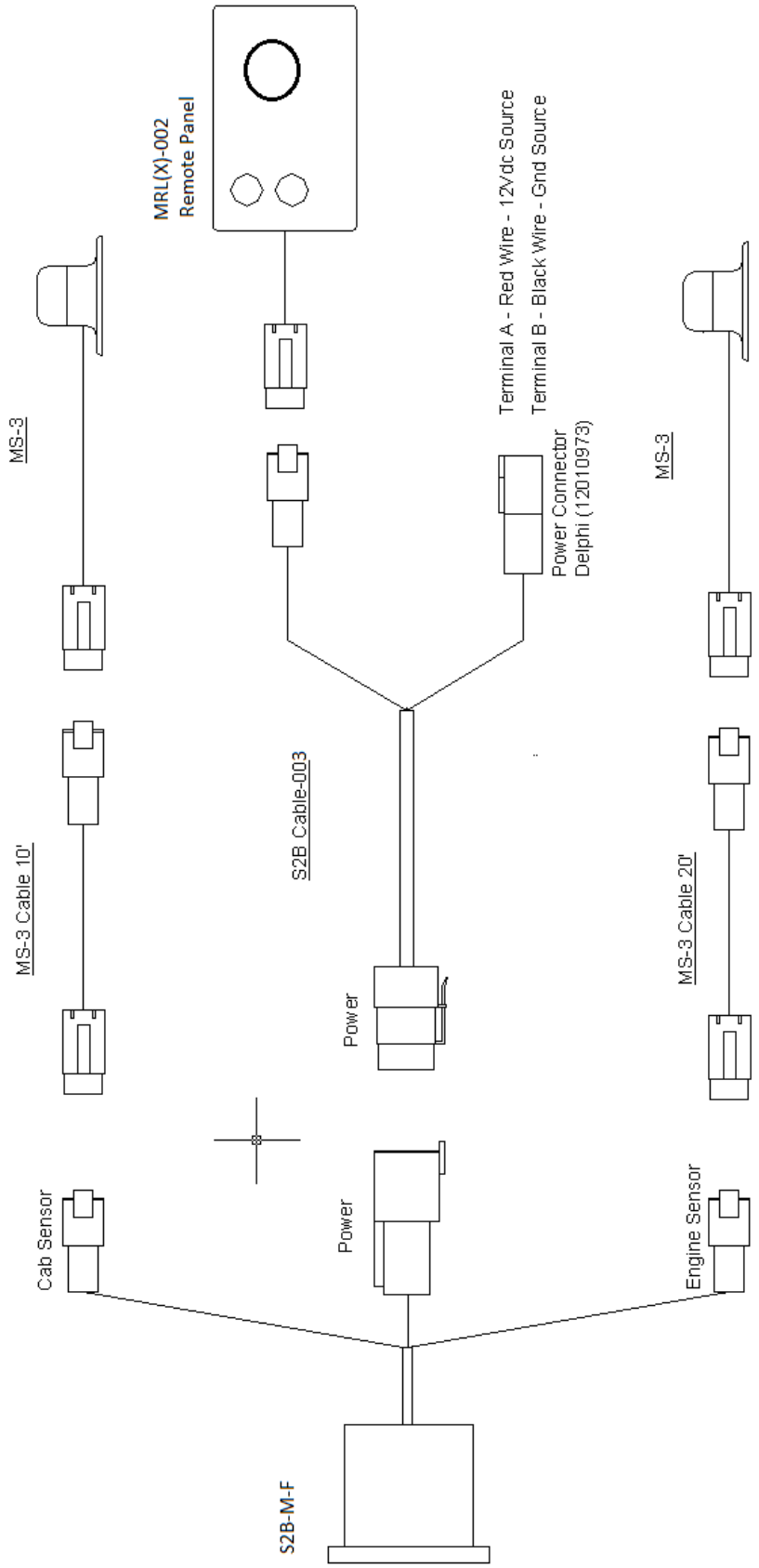
To switch an auxiliary device connect the blue or green wire to the ground of the device to be switched. When 50% of the LEL of methane is detected the internal relay will close connecting Gnd to the blue and green wires.

Plug the appropriate connectors into the display.
Cables are available in various lengths to allow remote mounting of the sensors. (See Optional Components)

System Diagram with Splitter



System Diagram for Remote Panel



Operation

When first turned on the display will sequence through each of the LEDs to confirm operation. It will also cycle the output relay.

After startup the LEDs will illuminate as described in the "Manual Displays" section.
If methane is detected the warning or danger LED will turn on depending on concentration.

If methane is detected at 50% of the LEL or greater then the LED indicator will remain on in addition the relay will activate. (generally connected to an external horn)

Testing Display Mode

Internal operation of the display mode may be tested using the corresponding TEST switch. Pressing the test buttons will test the LEDs and relay function.

Sensor Fault Detection

Should the unit determine that either of the sensors is faulty or disconnected, the "Service Required" LED will turn on.

Nuisance Alarms

The sensor used for the MShield is sensitive to hydrocarbons- an alarm may be triggered by the use of other chemicals such as cleaners, paint, polish, etc… The sensors will also detect hydrogen fumes from an overcharged battery. If no gasoline fumes are present, check for recent use of cleaners, fiberglass repairs, strong adhesives, etc… If none of these are present, the sensor may have been damaged and will need replacement.

WARNING

The MShield has been designed to alarm visually at 20% of the LEL (Lower Explosive Limit) of Methane and alarm visually and audibly at 50% of the LEL. Implement immediately the following procedures in the event of an alarm. Manually shut off the source of Methane if possible. Turn off all electrical circuits EXCEPT circuits, which operate blowers and/or exhaust fans. Remove all personnel from the area. Ventilate the area. Carefully check all fuel lines, tanks and fittings to locate the leak. Have the problem repaired by qualified personnel.

Maintenance

The MShield requires very little maintenance. Periodically examine the sensors for contamination or damage. Check that sensor wires are not frayed, pinched, or cut. Test the operation of both sensors and display frequently. Do NOT expose sensors to liquids or chemicals.
When cleaning, seal off the sensor(s) with a plastic covering. Harsh chemicals may damage the sensor. Keep sensor(s) sealed until the compartment has been completely ventilated. The sensors need to be tested three times per year (NFPA 52, section 9.13.3.2.1) and after any incidental contact with a harsh chemical/environment.

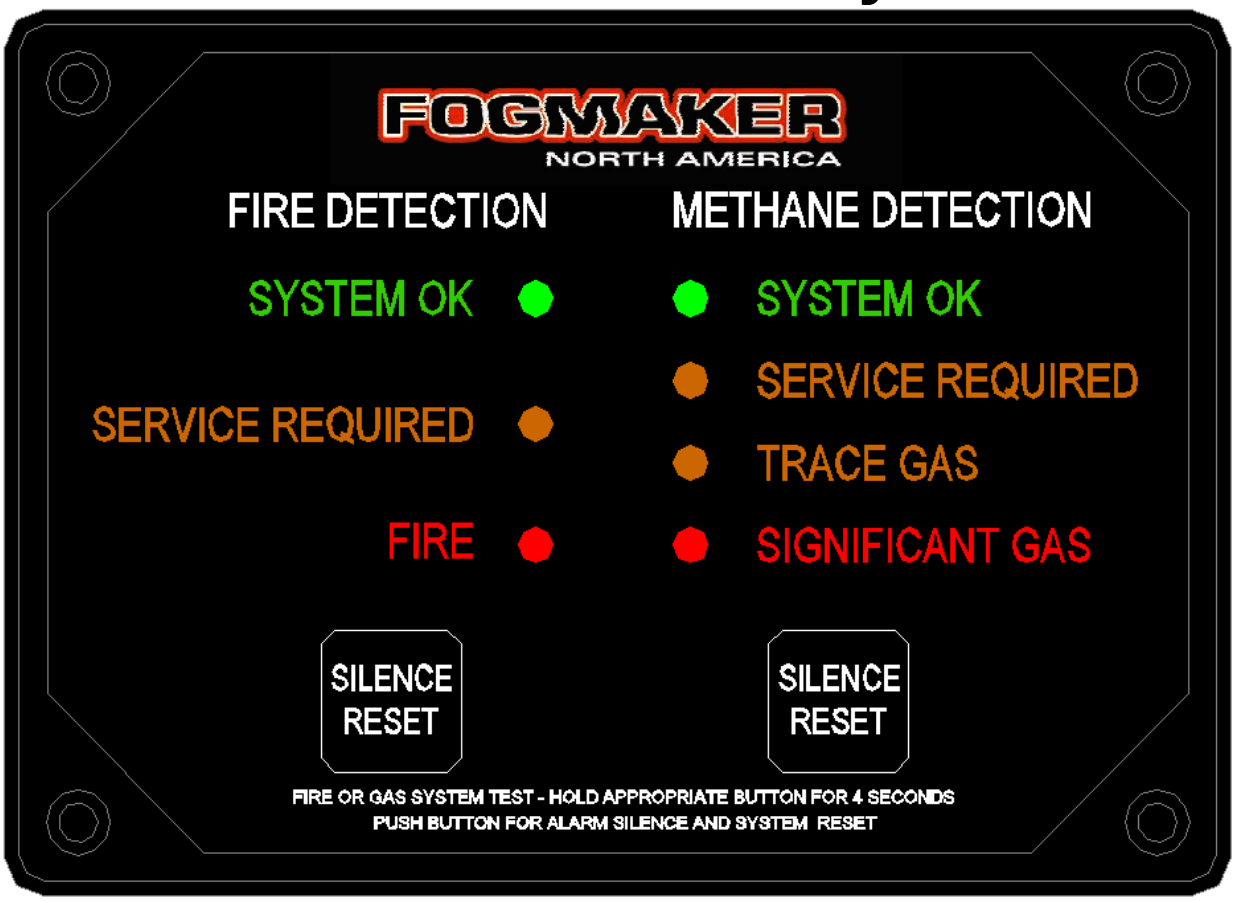
Specifications

Voltage ……	+12VDC Nominal (10VDC min to 18VDC max)
Alarm ……	Visual @ 20% of LEL Relay @ 50% of LEL
Relay..... ……	1 amp max
Display Current ……...	30 mA
Sensor Current ……	75 mA
Splitter01 current…….	40 mA
MRL(X)-00X Current……..	30 mA

WARNING The MShield is a Methane detector ONLY. This device is meant to serve as a supplement warning only. It is NOT intended to replace standard safety practices which should be carried out around explosive gases (i.e. inspect all compartments, check all gas fittings and connections, smell for methane gas fumes, etc…) To function properly the MShield must be powered at all times. Before installing in applications which may appear different than those outlined in this manual, contact the manufacturer. This device is not intended for use in aircraft.

There are no user or field serviceable parts in this product. The MShield must be returned to the manufacturer for any repair or trouble shooting beyond what is recommended in this manual. Installation shall be done by qualified personnel authorized to do so by the authorities having jurisdiction for the particular application in which the product is being used. Electrical wiring shall be in accordance with applicable codes. Improper wiring, including all wire connections, may render the unit inoperable, damage components, or cause a fire, and will void all warranties

Manual for Fire Suppression & Methane Detection System



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READ THIS MANUAL CAREFULLY AND SAVE FOR FUTURE REFERENCE. KEEP THIS MANUAL WITH THE FM-US-400018 (in-dash mount) OR FM-US-400032 (surface mount).

Introduction

The FM-US-400018/FM-US-400032 vapor-monitoring system utilizes advanced technology for detection of methane fumes. The FM-US-400018/FM-US-400032 allows the connection of (2-4) sensors and has both visual and audible alarms that trigger at 20% and 50% LEL (Lower Explosive Level) of methane respectively. Test switches are provided for full testing of all operations. System operation and correct sensor operation are continually monitored and indicators are provided for fault detection. The FM-US-400018/FM-US-400032 has an internal relay for automatic control of an external device up to 1 amp. The FM-US-400018/FM-US-400032 also has a fire detection system built in. It has the ability to monitor pressure switches, IR-Thermal switches, and other contact type inputs. These inputs will control the indicators on the display to alert a user of service needed or in case of a fire. They also control the engine shutdown relay and one input has its own separate output. This output switches system voltage or ground out if a condition occurs. Read this owner's manual completely before installation. Failure to read and follow these instructions can result in damage to the unit voiding the warranty.

DANGER! NO POWER ON/OFF SWITCH IS PROVIDED FOR THIS UNIT. TO FUNCTION AS INTENDED, THE FM-US-400018/FM-US-400032 MUST BE CONNECTED TO A SUITABLE POWER SOURCE AND BE POWERED CONTINUOUSLY.

DANGER! UNLIKE CNG, LNG HAS NO IDENTIFIABLE ODOR. IF AN LNG LEAK IS DETECTED BY THE METHANE SYSTEM TAKE EXTREME CAUTION!

CAUTION: IF POWER IS ON AND LEFT UNATTENDED FOR AN EXTENDED PERIOD OF TIME, BATTERY POWER MAY BE DIMINISHED.

Manual Display Controls / Indicator

Fire Detection

OK - Green when there is no fire detected or service required
Service Required – Orange when pressure has dropped in detector bottle or piston accumulator.
Fire – Red when pressure lost or fire detected/occurred.

Methane Detection

OK – Green when there is no service required and no gas detected
Service Required – Orange when sensor is disconnected or malfunction detected
Trace Gas – Orange when methane is detected between 20% and 50% LEL
Significant Gas – Red when methane is detected over 50% LEL

Display Installation

The FM-US-400018/FM-US-400032 should be mounted in a convenient location, preferably where the visual indicators may be readily seen. To install the display, you must first cut a rectangular opening 4 1/8" x 2 1/4".
Secure the display at the four corners with #6 screws.

Sensor Installation

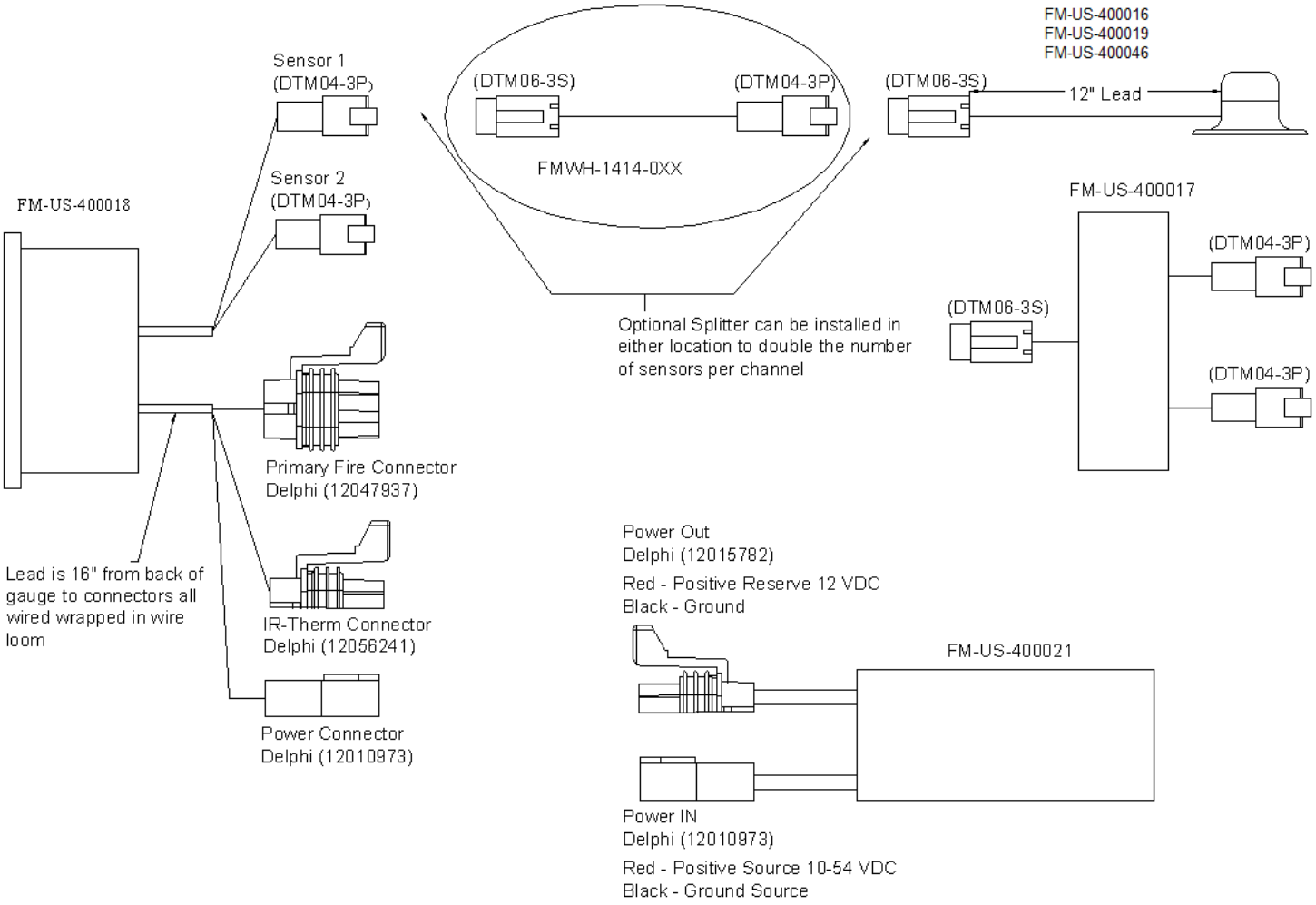
The sensor can be mounted horizontally or vertically on a flat surface. It is important for the surface to be flat to prevent bowing of the housing.

CNG (Compressed Natural Gas) is lighter than air and will rise. Therefore, it is important that a location be selected that is within nine (9") inches (22.86cm) of the ceiling height. Do not locate sensor directly in the path of any kind of constant external air flow or sources of contamination. Keep sensor dry.

Once the location has been selected peel the backing paper off of the sensor and stick in its desired location. Place a #8 washer on a #8 pan head screw and insert through the hole in the sensor ear to secure. Repeat on the other ear. Do not use Loctite as it can cause the sensor housing to crack. Use a lock washer or locknut instead. Tighten the screws to 20 in-lbs, do not over tighten.

Wiring the FM-US-400018/FM-US-400032

The display has five connectors for external connections and one pink wire for battery back-up.
See diagram below for connections. See the table for connector pin outs. FM-US-400018/FM-US-400032 has an in line fuse on the positive cable.



Optional Equipment

- FM-US-400016 Methane Sensor
- FM-US-400017 Allows for additional MS-3 or MS-4 sensor to be connected to a system
- FM-US-400019 Methane Sensor with built in LED
- FM-US-400020 Methane Sensor 90 degree mounting bracket
- FM-US-400021 Rechargeable battery backup unit for 10-54 Vdc
- FM-US-400046 Aluminum Methane Sensor with built in LED
- FMWH-1414-0XX Extension Cable for MS-3/MS-4 Sensor (0XX = length in 5' increments)

Connector	Pin	Function	Color	Gauge
Primary Fire Connector	A	Gnd from display	W	18
	B	50 Bar in switch (if 50 Bar is open & 14 Bar is closed then service lights. If 50 Bar & 14 Bar are open then fire lights, siren sounds, relay activation)	Y	18
	C	5 Bar in switch (if 5 Bar is open & 14 Bar is closed then service lights. If 5 Bar & 14 Bar are open then fire lights, siren sounds, relay activation)	Blk	18
	D	Relay Option (if disconnected no relay delay, if connected to system voltage 15 second delay on relay)	Grn	18
	E	14 Bar in switch (if 14 Bar is open & 50 or 5 Bar is closed then service lights. If 14 Bar & 50 or 5 Bar are open then fire lights, siren sounds, relay activation)	Br	18
	F	NC output for Engine relay	O	18
	G	NO output for Engine relay	R	18
	H	Common input for the Engine relay. Relay is triggered by 50Bar, 5Bar, IR-Thermal or Methane in Danger.	Bl	18
IR-Thermal Connector	A	IR-Thermal switch input. (if closed fire lights, siren sounds, 15sec delayed relay activation)	Bl	18
	B	Switched system voltage on closed IR-Thermal switch	R	18
Power Connector	A	Power (10V-54V)	R	18
	B	Ground input for display	Blk	18
Sensor 1	1	12V to sensor (regulated by display do not by-pass)	R	22
	2	Methane signal out from sensor	Grn	22
	3	Ground to sensor (can be by-passed and grounded remotely)	Blk	22
Sensor 2	1	12V to sensor (regulated by display do not by-pass)	R	22
	2	Methane signal out from sensor	Grn	22
	3	Ground to sensor (can be by-passed and grounded remotely)	Blk	22

Testing Display Mode
If no alarm conditions are present, holding either SILENCE/RESET button down for 4 seconds will initiate a self test sequence. During this sequence all LEDs will cycle along with the engine relay and siren.

Sensor Fault Detection
Should the unit determine that either of the methane sensors are faulty or disconnected, the "Service Required" LED will illuminate.
In the case of service required, the vehicle should be stopped and pulled from service until the sensor / system is serviced and the "Service Required" LED is cleared.

FM-US-400019 and FM-US-400046 sensors are also equipped with an LED to indicate each state of operation.

Solid On - Everything is ok no methane present
LED off - Sensor is in fault or is not plugged in
Slow Flash - Sensor is detecting trace gas (20% LEL)
Fast Flash - Sensor is detecting significant gas (50% LEL)

Engine Relay
The engine relay is controlled by both the fire and methane detection systems and has (C, NO, NC) dry contacts for multiple wiring options.
If the "Fire" or "Significant Gas" lights come on the relay will turn on immediately. If the green wire is connected to system voltage the relay will turn on after 15 seconds. (See connector table.)

IR-Thermal Relay
This relay has the common tied to system voltage and is normally open. When a ground is present at the IR-Thermal input the relay closes sending out system voltage.

Button Operation
Either SILENCE/RESET button can be used for each system. When there are no alarm conditions, holding either button for 4 seconds will initiate a self test sequence.
If the siren is sounding, holding either button in for 1 second will mute the siren for 15 seconds.

Engine Relay
If the engine relay is activated, holding either SILENCE/RESET button will reset the relay for 250mS to signal the bus's monitoring system.

If the green wire is connected to system voltage and the engine relay is activated, holding either button for 5 seconds will cause the relay to reset for 15 seconds allowing the vehicle to start. (See connector table.)

DANGER! CHOOSING TO OVERRIDE THE METHANE SYSTEM DURING A 50% LEL ALARM CAN RESULT IN AN EXPLOSION. EXTREME CAUTION SHOULD BE TAKEN BEFORE OVERRIDING THE SYSTEM.

Nuisance Alarms
The sensors used for the FM-US-400018/FM-US-400032 are sensitive to hydrocarbons but an alarm may be triggered by the use of other chemicals such as cleaners, paint, polish, etc. The sensors will also detect hydrogen fumes from an overcharged battery. If no hydrocarbon fumes are present, check for recent use of cleaners, fiberglass repairs, strong adhesives, etc. If none of these are present, the sensor may have been damaged and will need replacement.

WARNING:
The FM-US-400018/FM-US-400032 has been designed to alarm visually at 20% of the LEL (Lower Explosive Limit) of methane and alarm visually and audibly at 50% of the LEL. Implement immediately the following procedures in the event of an alarm. Manually shut off the source of methane if possible. Turn off all electrical circuits EXCEPT circuits which operate blowers and/or exhaust fans. Remove all personnel from the area. Ventilate the area. Carefully check all fuel lines, tanks and fittings to locate the leak. Have the problem repaired by qualified personnel.

Panel Logic:

Brown wire 14 Bar Switch Detector Container	Black wire 5 Bar Switch Detector Container	Yellow wire 50 Bar Switch Piston Accumulator	Evaluation of Signal	Light
0	1	1	Pressure loss in detection	Service Required
1	0	1	Pressure switch 5 bar faulty or cable disruption	Service Required
0	0	1	Fire	Fire
1	1	0	Pressure loss in Piston accumulator	Service Required
0	0	0	Fire	Fire
0	1	0	Fire	Fire
1	1	1	System OK	System OK
White wire is common ground for all 3 switches				

Testing the operation of the fire suppression system:

1. Connect all wires and arm the fire suppression system. Turn on the bus. After the automatic system test runs if everything is connected and the bottles charged to the correct pressure the green "SYSTEM OK" light should be illuminated.

2. Disconnect the connection between the 50 bar pressure switch and the wire harness. This is labeled "EXT PR SW". The "SERVICE REQUIRED" light will be illuminated. Reconnect after this is verified.

3. Disconnect the connection between the 14 bar pressure switch and the wire harness. This is labeled "DET CYL PR SW". The "SERVICE REQUIRED" light will be illuminated. Reconnect after this is verified.

4. Disconnect the connections between the 14 bar pressure switch and the 50 bar pressure switch. The "FIRE "light will be illuminated. The siren will sound. The relay will activate (unless the green wire is connected to system voltage. See connector table.). Press Silence reset button for 1 second to silence the alarm. To restart the bus hold the Silence reset button for 4 seconds to reset the 15 second timer.

If system is equipped with the optional 5 bar pressure switch:

1. Disconnect the connection between the 5 bar pressure switch and the wire harness. This is labeled "5 BAR SW". The "SERVICE REQUIRED" light will be illuminated. Reconnect after this is verified.
2. Disconnect the connections between the 5 bar pressure switch and the 14 bar switch. The "FIRE "light will be illuminated. The siren will sound. The relay will activate (unless the green wire is connected to system voltage. See connector table.).
3. Disconnect the connections between the 14 bar pressure switch, the 50 bar pressure switch and the 5 bar pressure switch. The "FIRE "light will be illuminated. The siren will sound. The relay will activate (unless the green wire is connected to system voltage. See connector table.).

Maintenance

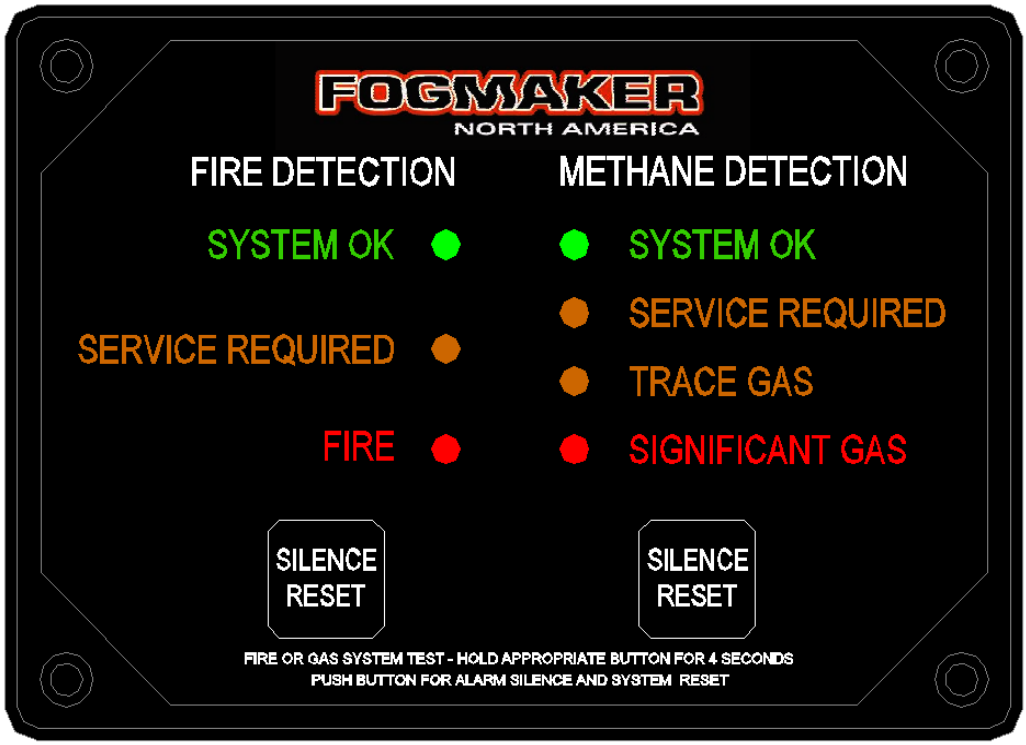
The FM-US-400018/FM-US-400032 requires very little maintenance. Periodically examine the sensors for contamination or damage. Check that sensor wires are not frayed, pinched, or cut. Test the operation of both sensors and display frequently. Do NOT expose sensors to liquids or chemicals.
When cleaning, seal off the sensor(s) with a plastic covering. Harsh chemicals may damage the sensor. Keep sensor(s) sealed until the compartment has been completely ventilated.

Specifications 3A Fuse

Voltage ……	+12VDC Nominal (10VDC to 48VDC)
Temperature……	-40F to 158F operating (-40F to 170F storage)
Alarm ……	Visual @ 20% of LEL Relay @ 50% of LEL
Relay..... ……	1 amp max
Display Current ……..	50 mA
Sensor Current ……	75 mA
Splitter01 current…….	40 mA

WARNING The FM-US-400018/FM-US-400032 is for fire and methane detection. This device is meant to serve as a supplemental warning only. It is NOT intended to replace standard safety practices which should be carried out around explosive gases (i.e., inspect all compartments, check all gas fittings and connections, smell for methane gas fumes, etc.) To function properly the FM-US-400018/FM-US-400032 must be powered at all times. Before installing in applications which may appear different than those outlined in this manual, contact the manufacturer. This device is not intended for use in aircraft.
There are no user or field serviceable parts in this product. The FM-US-400018/FM-US-400032 must be returned to the manufacturer for any repair or trouble shooting beyond what is recommended in this manual. Installation shall be done by qualified personnel authorized to do so by the authorities having jurisdiction for the particular application in which the product is being used. Electrical wiring shall be in accordance with applicable codes. Improper wiring, including all wire connections, may render the unit inoperable, damage components, or cause a fire, and will void all warranties

Methane Detector Test Procedure
(for Aluminum-housing sensors)



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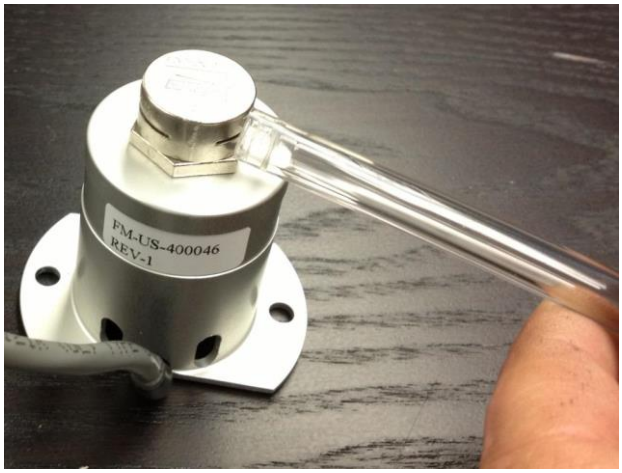
Methane Fume Detector/Fire Detection System
Methane Sensor Test Procedure
MADE IN THE USA

1. Start Engine to Vehicle and wait for Methane Detection "System OK" light to illuminate on Fogmaker Control Panel

2. Open and assemble Calibration Kit as shown in the image below, by:
    a. Screwing regulator/valve onto desired test bottle and ensure that gauge reads 100 psi or greater (if not, replace bottle)
    b. Assembling clear tube to output of regulator/valve

3. Begin the flow of test gas by turning thumb screw on regulator/valve counterclockwise until it stops.

4. Hold opening free end of clear tubing against one of two slots in cap of detector to be tested, as shown in the image below:



5. When using 20% or 25% LEL bottle, the alarm panel will illuminate the light for "Trace Gas." If the sensor under test is equipped with an indicator LED, it will change from solid red during normal vehicle operation, to a slow blinking red light upon detection of trace gas. Both indications (if applicable) will occur simultaneously, and within two minutes of application of test gas.

6. Remove clear tubing from methane detector, close regulator/valve knob (by turning clockwise) and wait for alarm panel "Trace Gas" light to turn off and "system OK" light to illuminate again.

7. Repeat steps 3 through 6 for all other detectors in vehicle.

8. Once all detectors have been tested at the 20% or 25% LEL level, disconnect test gas bottle from regulator/valve and replace with 50% LEL bottle.

9. Repeat steps 3 and 4, above.

10. When using 50% LEL bottle, the alarm panel will illuminate the light for "Trace Gas" and the detector LED (if so equipped) will change from solid red to slow blink within one minute of application of this test gas. Within two minutes of application of 50% LEL test gas, the alarm panel will illuminate the light for "Significant Gas" and sound the audible alarm. If the sensor under test is equipped with an indicator LED, it will change from solid red during normal vehicle operation, to a slow blinking red light upon detection of trace gas, to a rapid blinking red light upon detection of significant gas. Continue to apply test gas to sensor after this occurs. After 15 seconds of significant gas detection, the control panel will shut the vehicle engine off.

11. Remove clear tubing from methane detector, close regulator/valve knob (by turning clockwise) and wait for alarm panel "Trace Gas" light to turn off and "System OK" light to illuminate again.

12. Restart engine and wait for "System OK" light to illuminate if addition sensors are to be tested

13. Repeat steps 9 through 12, above for all other detectors in vehicle.

Interpretation of Results

- If all detectors behave as described in steps 5 and 10, above, all detectors and system are functioning properly.

- If all or several consecutive detectors do not function as described in steps 5 and 10, above, ensure that gauge on regulator/valve still reads at least 100 psi. If not, replace bottle and repeat test.

- If both bottles are known to be of sufficient pressure and one or more detectors do not function as described in steps 5 and 10, above, replace malfunctioning sensors with new units.